DRAFT REPORT

ENGINEERING EVALUATION/COST ANALYSIS

AVERY LANDING SITE
AVERY, IDAHO

Submitted To: Potlatch Land and Lumber, LLC

Submitted By: Golder Associates Inc.
18300 NE Union Hill Road, Suite 200
Redmond, WA 98052 USA

Distribution:

1 Copy	Stoel Rives, LLP, Kevin Beaton
4 Copies	EPA, Earl Liverman

January 25, 2010

Project No. 073-93312-03.9

A world of capabilities delivered locally

Golder Associates

Table of Contents

List of Tables

List of Figures

List of Appendices

List of Acronyms

amsl	above mean sea level
AOC	Administrative Order on Consent
bgs	below ground surface
btoc	below top of casing
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CDC	Conservation Data Center
cfs	cubic feet per second
COPCs	contaminants of potential concern
COC	contaminants of concern
DI	Deionized
EE/CA	Engineering Evaluation/Cost Analysis
E & E	Ecology & Environment Inc.
EPA	U.S. Environmental Protection Agency
FHA	Federal Highway Administration
FWS	U.S. Fish and Wildlife Service
Golder	Golder Associates Inc.
HSA	hollow-stem auger
IDAPA	Idaho Administrative Procedures Act
IDEQ	Idaho Department of Environmental Quality
IDFG	Idaho Department of Fish and Game
IDWR	Idaho Department of Water Resources
LNAPL	light, non-aqueous phase liquids
MCL	maximum contaminant level
mg/kg	milligrams per kilogram
mg/L	milligrams per litre
Milwaukee Railroad	Chicago, Milwaukee, St. Paul and Pacific Railroad Company
µg/L	microgram per litre
NTU	nephelometric turbidity units
NWTPH-Dx	Northwest Total Petroleum Hydrocarbons-Diesel extended
PA	Preliminary Assessment
PAHs	polynucleated aromatic hydrocarbons
Potlatch	Potlatch Forest Corporation and Potlatch Corporation
PCBs	polychlorinated biphenyls
PQL	Practical Quantification Limit
QA	quality assurance
QP	quality procedures
QAPP	Quality Assurance Project Plan
RAO	removal action objectives
ROW	right-of-way
SAP	Field Sampling Analysis Plan
SIDS	Sample Integrity Data Sheets
SVOC	semi-volatile organic compound
Site	Avery Landing Site, Avery Idaho
TAL	Target Analyte List
USFS	United States Forest Service
VOC	volatile organic compounds
Work Plan	Engineering Evaluation/Cost Analysis Work Plan for the Avery Site

1.0 INTRODUCTION

This document is the Engineering Evaluation/Cost Analysis (EE/CA) Report prepared by Golder Associates Inc. (Golder) for Potlatch Land and Lumber (referred to herein as Potlatch) at the Avery Landing Site (Site). The scope and procedures used for this investigation were defined in the EE/CA work plan (January 23, 2009) developed by Golder for Potlatch pursuant to Administrative Order on Consent (AOC) No. 10-2008-0135 between Potlatch and U.S. Environmental Protection Agency (EPA). The Site is located along State Highway 50 about 0.75 mile west of Avery, Idaho (Figures 1-1 and 1-2) in northern Idaho.

1.1 Statement of Purpose

The purpose of this field investigation, as defined in the EE/CA work plan dated January 23, 2009 was to assess the environmental impacts associated with the release of petroleum and other substances at the Site in order to select a removal action under the auspices of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. § 9601 *et seq* and under Section 311 of the Clean Water Act (CWA), 33 U.S.C. § 1321, as amended by the Oil Pollution Act (OPA) of 1990, 33 U.S.C. § 2701 *et seq*. This work was performed by Golder on behalf of Potlatch as a CERCLA Non-Time-Critical Removal Action with oversight by the EPA. The AOC contains the required scope of work for completing the EE/CA. The EE/CA was conducted in conformance with *Guidance on Conducting Non-Time-Critical Removal Actions under CERCLA* (OSWER Directive 9360.0-32). This document presents results from the field investigation and an evaluation of potential removal actions to satisfy the AOC.

1.2 Objectives of EE/CA

The primary objective of this EE/CA was to identify the nature and extent of petroleum and other substance impacts at the Site and, to select a removal action. Releases of petroleum and other substances from the Site that have impacted or have the potential to impact soil, groundwater, sediments, and surface water will be adequately understood to the extent that removal action decisions can be made.

Specific data needs and evaluation objectives of this field investigation included obtaining sufficient information to provide the following:

- An understanding of Site-specific geologic and hydrogeologic characteristics affecting groundwater flow onto and beneath the Site
- A characterization of the nature, extent, and potential sources of petroleum and other substance releases at the Site
- An assessment of the groundwater and surface water impacts from the Site releases
- An evaluation of the potential routes of exposure and risks to human and ecological receptors associated with releases or threatened releases of petroleum substances

The objectives of the removal action evaluation include the following:

- Define removal action objectives specific to the Site risks
- Identify and screen (initially) applicable removal/treatment actions
- Estimate the cost of each potential removal action
- Evaluate potential removal actions with respect to their effectiveness, implementability, and cost
- Recommend a preferred removal action for the Site

1.3 EE/CA Report Organization

This EE/CA Report is organized into ten sections and 9 appendices. The contents of the sections are as follows:

- Section 1.0 provides general introductory information and identifies the objectives of the EE/CA.
- Section 2.0 provides general information regarding the Site including the location, type of former operations conducted at the Site, and a synopsis of the Site history.
- Section 3.0 provides results of the EE/CA investigation.
- Section 4.0 presents a description of contaminants of potential concern and the extent of contamination.
- Section 5.0 provides a human health and ecological risk assessment.
- Section 6.0 presents removal action objectives.
- Section 7.0 presents a screening of removal technologies.
- Section 8.0 provides the development and screening of the removal alternatives using a comparative analysis.
- Section 9.0 describes the retained action alternatives.
- Section 10.0 presents a detailed evaluation of selected removal alternatives.
- Section 11.0 lists the references cited in this EE/CA Report.

The following 9 appendices are included in this EE/CA Report:

- Appendix A contains copies of logs for the test pits, soil borings, and groundwater monitoring wells installed during this EE/CA investigation.
- Appendix B contains the sample integrity data sheets for all of the groundwater, surface water, and sediment samples collected during the EE/CA investigation.
- Appendix C contains laboratory analytical reports and data validation information. This appendix is on a CD.
- Appendix D contains data from hydraulic test conducted during this EE/CA investigation.
- Appendix E contains geodetic data collected during this EE/CA investigation.
- Appendix F contains a treatability study for contamination identified at the Site.
- Appendix G contains historical reports.
- Appendix H contains a summary of pertinent federal and state laws and regulations that may be considered applicable or relevant and appropriate (ARAR) for the Site.

- Appendix I contains the human health risk evaluation calculations.
- Appendix J contains data gathered from the USFWS pertaining to ecological receptors at or near the Site.
- Appendix K contains the cultural resource assessment.
- Appendix L contains the alternatives evaluation cost details.

2.0 SITE BACKGROUND

The following sections provide general information regarding the Site including the location, type of historic operations conducted at the Site, and a synopsis of the Site history. The geography and topography of the area are described along with descriptions of the regional geology and soils, adjacent land use, surface and groundwater, and meteorology.

2.1 Site Location and Description

The approximate 6-acre Site is located in the St. Joe River Valley in the Bitterroot Mountains of northern Idaho. It is about 0.75 mile west of the town of Avery, Idaho. Figures 1-1 shows the location of the Site. The Site is within the northwest quarter of Section 15, Township 45 North, Range 5 East and the northeast quarter section of Section 16, Township 45 North, Range 5 East, Willamette Meridian. The approximate latitude is 47° 13' 57'' North and longitude is 115° 43' 40'' West.

The Site is comprised of the following four contiguous properties, as shown on Figure 1-2:

- Federal Highway Administration (FHA) property which includes Highway 50 (also known as St. Joe River Road).
- Bentcik property (eastern half of the Site) which contains a vacation cottage and numerous monitoring wells and piezometers for monitoring groundwater. There is no groundwater supply well on the Bentcik property.
- Potlatch property (western portion of the Site) which is generally undeveloped with numerous monitoring wells and piezometers for monitoring groundwater. Formerly, there were several residential buildings in the central portion of the Potlatch property as well as historic motor home utility hook-ups. All the residences were vacated and subsequently demolished in September 2009.
- State of Idaho owns the St. Joe River beds and banks along the southern portion of the Site.

There are no permanent residences on the Site. A house exists on the Bentcik property that is used as a vacation cottage by the Bentcik family. Water supply to this house is obtained by a gravity fed pipe capturing spring water from the draw directly north from the Bentcik Property, across Highway 50. The spring is at an elevation approximately 50 feet above highway 50. This water supply is only used for irrigation, and livestock watering. Potable water for human consumption is supplied by bottled water.

A domestic groundwater supply well, located in the western/central portion of the Potlatch property, has been disconnected and is not in use. Historically this groundwater supply well provided domestic water to seasonal residences and a series of temporary trailers on the western/central portion of the Site. In the summer and fall of 2009, a demolition company, retained by Potlatch, removed all of the residences and structures that previously utilized this well. Water hook-ups for the former trailer sites have been disconnected and are no longer capable of supplying water service.

Presently the Site is relatively flat ground covered with gravel and sparse vegetative growth. There is an area of widely spaced trees in the center of the Site. Shallow soils are mainly fill materials, presumably used to create a larger flat area for historic railroad operations.

2.1.1 Adjacent Property Uses

The Site is in the remote and narrow St. Joe River Valley. To the north, the St. Joe River Valley steeply rises into mountainous terrain and is used for recreation and wildlife habitat. The land immediately to the east and west of the Site does not contain homes or facilities, but is used primarily for seasonal recreation, riparian wildlife habit, and access to the St. Joe River.

Approximately 0.75 miles east of the Site, along Highway 50 is Avery, Idaho; a small unincorporated town. Avery has a permanent population between of 50-60 residents. The population is much higher in the summer months because of seasonal workers and vacationers. Outdoor recreational activities such as camping, hunting, hiking, and fishing are popular with visitors.

The St Joe River borders the Site to the south. The river discharges to Coeur d'Alene Lake via Chatcolet Lake in the Heyburn State Park and is part of the Spokane River Drainage Basin. It is a special resource river that is used for wildlife habitat, recreation, and as drinking water for downstream residents. According to the Idaho Administrative Procedures Act (IDAPA) (IDAPA 58.01.02.110.11), the segment of the St. Joe River adjacent to the Site has the following designations: special resource water, domestic water supply, primary contact recreation, cold water communities, and salmonid spawning.

Historically, native game fish in the river include westslope cutthroat trout (*Oncorhynchus clarki lewisi)*, bull trout (*Salvelinus confluentus*), and mountain whitefish (*Prosopium williamsoni*)=(Idaho Department of Fish and Game). This section of the St. Joe River has been designated as a catch-and-release fishing area for cutthroat trout. Other species of fish found in the river include bull trout, rainbow trout (*O. mykiss*) and Dolly Varden (*S. malma*).

The Site is located within Region 1, Hunting Unit 6 (Idaho Department of Fish and Game). In this management unit, the Department issues hunting permits for the following big game: Deer, Elk, Bear, Moose, and Wolves. In addition to big game, smaller game such as rabbits and furbearers are hunted as well as a wide variety of birds (water fowl and upland birds).

2.2 Site History

2.2.1 Ownership History

Historically, the Site was owned and operated by the Chicago, Milwaukee, St. Paul and Pacific Railroad Company. Currently, the Site is owned by four parties: The eastern portion is owned by Mr. Larry Bentcik, the western portion is owned by Potlatch; the northern portion of both properties is owned by the Federal Highway Administration (FHA) and includes State Highway 50. The FHA acquired the northern

portion in 1986 for construction of the Highway 50 (URS 1993). The fourth owner is the State of Idaho who owns the beds and banks of the St. Joe River below the ordinary high water mark. The boundary between Sections 16 and 15 of T45N R5E separates the Bentcik and Potlatch properties.

2.2.2 Historic Operations

In the early 1900s, the Site was developed by the Chicago, Milwaukee, St. Paul, and Pacific Railroad (Milwaukee Road) as a railroad switching yard, light maintenance facility, and fueling depot. See Figure 2-1 for a depiction of the historic railroad facility. The floodplain provided a relatively flat site bordering the St Joe River. Today, there is little remaining at the Site to indicate its previous use, except concrete foundation slabs and remnants of rail lines. The railroad spurs were reportedly removed in 1986. Before Potlatch purchased the property, the railroad had removed most of the equipment and structures from the Site.

After acquiring the western portion of the Site in 1980, Potlatch performed additional leveling and grading and used the area for temporary log storage. Portions of the Potlatch site were leased to third parties for a variety of uses including log storage, parking, and trailer sites. Since acquiring the eastern portion of the Site in 1996, Mr. Bentcik has used it for a vacation cabin. (E&E Report July 31, 2007).

2.2.3 Historic Railroad Operations On Site

The Milwaukee Road operated on the Site from 1907 to 1977. From 1916 until the advent of diesel engines, westbound locomotives coming through Avery changed from electric to steam power. Avery was the western terminus of electric power (Johnson, 2003). Because of concerns about potential forest fires, locomotives operating within National Forest lands were required to burn oil rather than coal or wood. A thick oil, referred to as 'Bunker C' was frequently used in the early 1900s. With the advent of diesel-powered engines in the 1940s and 1950s, Bunker C was replaced with diesel fuel.

Based on a review of a facility map dated 1915 (Figure 2-1), railroad operations at the Site within Section 16 of T45N R5E included the following:

- Railroad switchyard with train roundhouse and turntable
- Engine houses
- Railroad maintenance and machine shop

Railroad operations at the Site within Section 15 of T45N R5E included the following:

- Fuel oil unloading, storage, and train fueling depot
- Maintenance supply storage

2.2.3.1 Railroad Operations Off-site in Avery, Idaho

As the western terminus of the electrified rails, the Avery yards needed facilities to handle both electric and fuel-powered locomotives. Electrical service was provided by Substation No. 14 which was located in the town of Avery, east of the passenger depot. Avery is approximately 0.75 miles east of the Site. A Preliminary Assessment (PA) conducted by IDEQ, dated May 9, 1991, documented an interview with Mr. Terry Stranton, United States Forest Service (USFS). Mr. Stranton recalled transformers and associated oils were stored at Substation No. 14. He did not have any information about whether or not these oils contained PCBs. Mr. Stranton also stated that transformers were stored at other locations within the yard but was unable to identify these on the 1915 map.

2.3 Physical Setting

This section describes the regional geologic and hydrogeologic settings followed by Site-specific geology encountered during subsurface investigations at the Site.

2.3.1 Regional Geologic Setting

The Site is along the St. Joe River in mountainous topography in northern Idaho. This area is within the Northern Rocky Mountain province along the south slope of the Bitterroot Mountains in the St. Joe River valley; generally trending east/west. The subsurface geology, and geology of the surrounding hills in Avery, Idaho is dominated by Precambrian (middle proterozoic) sedimentary deposits including carbonates, quartzite which are part of the Piegan Group, also known as the Middle Belt carbonate, Apple Creek Formation (Lewis 2002). These deposits were part of an intracratonic basin that was periodically connected to the ocean system and lacustrine and oceanic deposits can be found throughout the Group (Ross and Villeneuve 2003, Link et al. 2007). The depth to bedrock at the Site is unknown.

2.3.2 Soil

Soils in the area have been interpreted as the Pywell Series in river bottoms and Vy Series on mountain slopes (IDEQ May 9, 1991). Valleys are likely filled with alluvium underlain by mudstones and shales from the Precambrian Belt series (Wagner, 1949).

The Site has historically undergone extensive grading to make a suitable location for a railroad facility. As such, the Site is immediately underlain by unconsolidated sand and gravel fill materials existing from ground surface to approximately 11 feet thick, overlying mostly sand and gravel alluvial deposits. In various locations on-site during test pit excavation debris including concrete, wood waste, scrap metal, asphaltic material, and pipes of various material and dimensions were encountered. Some colluvium deposits are suspected to exist along the toe of the mountain sides in the northern most areas of the Site, although their occurrence has not been documented. The river bank, for approximately 700 feet length along the Site, was excavated and backfilled with fill soils and riprap rock placed on the riverside surface for armor to minimize bank erosion.

2.3.3 Climate

2.3.3.1 General Climatic Conditions

The climate at the Avery Landing Site is influenced by the surrounding mountainous terrain. The major weather fronts are from the Pacific Ocean and from the Canadian Arctic. National weather stations do not exist in Avery, Idaho. Based on data collected at regional weather stations, the area is characterized by dry summer continental climate and significant winter precipitation (Peel et al. 2007). The average temperatures in the summer reach 85º Fahrenheit, with the highest seasonal temperature occurring in July and August. The lowest average temperatures typically occur in January and average lows reach approximately 20º Fahrenheit. Overall seasonal lows range from 20º to 40º Fahrenheit with high temperature values ranging from 30º to 85º Fahrenheit annually.

2.3.3.2 Rainfall and Snowfall

Average annual precipitation (recorded at the Avery Ranger Station from 1968-2005) is 37.63 inches (Western Regional Climate Center, 2006). Precipitation values are highest during January. Most of the precipitation is snowfall, with an average annual snowfall of 77.6 inches. The lowest precipitation occurs during July and August with less than 1.5 inches of total precipitation on average. Precipitation intensities are predicted to be as follows (NOAA, 2008):

- 25 Year - 24 Hour precipitation event is estimated to be between 2.8 and 3 inches
- 100 Year – 24 Hour precipitation event is estimated to be between 3.4 and 3.8 inches

Average snow depth is highest in February with approximately 14 inches of snowfall on average. A recordable average of snow depth is seen from November through February with average snow depths declining to zero by March.

2.3.3.3 Wind

Wind speeds average between 4 and 6 miles per hour seasonally with the lowest average wind speeds in September. The available wind data period of record is 2008 to 2009 and historical wind speed values may have varied over longer periods of time.

2.3.4 Groundwater Characteristics

The interaction between groundwater and the St. Joe River is dynamic with season, antecedent rainfall and snow melt, and river levels. The flow of groundwater at the Site is revealed by the measurements of the groundwater static water levels. The groundwater flow pattern shifts seasonally at the Site due to the influence of fluctuating discharge levels on the adjacent St. Joe River. This is not uncommon in areas of mountainous streams that have fluctuating river levels and a developed floodplain. The groundwater at the Site ultimately discharges to the St. Joe River. The direction of groundwater flow is to the southwest during the summer and fall seasons. But during other parts of the year the groundwater flow direction can shift such that it is flows more parallel to the river and discharging further south into the river.

The groundwater within the Potlatch property is derived from either direct infiltration of meteoric precipitation, from groundwater flowing from the east (Bentcik property) or from groundwater flowing from the north (Federal Highway Administration property), and the adjacent mountainside. The contributing amount of water from each source is uncertain. The groundwater on the Bentcik portion of the Site may be influenced by the river, such that river water discharges into the Bentcik property. This is demonstrated by the April 2007 groundwater level measured in MW-5 (89.87 ft), which was higher than the groundwater level measured in EMW-02 (89.3 ft) and lower than EMW-01 (89.93 ft) (E & E 2007). Based on a triangulation of equipotentials among those three 2007 measurements, it appears that river water is moving into the groundwater. Groundwater characteristics and the relationship with the St. Joe River are discussed further in Section 4.

Evidence of groundwater seepage flowing from the Site into the river has been observed at several locations along the river bank (E&E, 2007). These seeps are generally located in the center of the Site.

2.3.5 Surface Water Characteristics

The St. Joe River flows from the east to west along the Site's southern boundary eventually discharging in to Coeur d'Alene Lake, 60 miles to the west. The Site is along a stretch of river that has a relatively low gradient compared to the river upstream. Based on data collected at the Calder gauging station (located approximately 23 miles down-stream from the Site), during spring snow melt in May, the river flows average between 7,000 and 8,000 cubic feet per second (cfs). In contrast, September river flows average between 400 and 500 cfs. Sudden storms, especially heavy rain on snow, can cause extreme river flows and flooding during warm periods in winter and spring. River flows have been measured from 30,000 to 50,000 cfs at Calder, Idaho (USGS, National River Data Base, 2008). St. Joe river levels can fluctuate more than 8 feet in stage height, at the Calder Station. River fluctuations may not be as high at the Site.

2.3.6 Ecological Resources

A request for a list of species within or in the vicinity of the proposed project area was submitted to US Fish and Wildlife Service (USFWS) by Earl Liverman (EPA) on 8 January, 2008. In a response letter dated 16 January 2008, USFWS indicated that two wildlife species federally listed as threatened occur near the project Area (Appendix J). These species include:

- Bull trout (Salvelinus confluentus)
- Gray wolf (Canis lupus)

In addition, the USFWS indicated that the St. Joe River is critical habitat for bull trout.

2.3.6.1 Gray Wolf

Since the date of the letter, in 2008, the gray wolf population in Idaho has been de-listed from the Endangered Species Act list. In December 2009, Bryon Holt (USFWS Upper Columbia Fish and Wildlife Office) confirmed that the gray wolf has been de-listed and the only threatened species that occurs near

the Project Area currently is bull trout. The USFWS rule de-listing gray wolves in the Northern Rockies and Western Great Lakes took effect May 4, 2009. The rule de-lists wolves in Idaho, Montana, and parts of Washington, Oregon and Utah, as well as the Western Great Lakes region.

2.3.6.2 *Bull Trout*

According to USFWS wildlife biologist Mr. Holt, and, "Critical Habitat For Bull Trout (*Salvelinus confluentus*), Unit 14: Coeur d'Alene Basin" the St. Joe River in the vicinity of the proposed project remains classified as critical habitat for bull trout (personal communication between Donna DeFrancesco, Golder Associates Inc., and Mr. Holt, December, 2009).

Ecological information about bull trout, and the likelihood of their occurrence or the likelihood for habitat on the proposed project area is described as follows.

As described in IDFG (2005), bull trout exhibit three life history types in the St. Joe River: adfluvial, fluvial and resident; all which require temperatures <16 C (<60 F) during portions of their life cycle to persist. Preferred temperatures are normally <12 C (<54 F). Adfluvial bull trout live in lakes and reservoirs as sub-adults and adults but migrate into tributaries to spawn. Fluvial bull trout live in major rivers and streams as sub-adults and adults but migrate into smaller tributaries to spawn, while resident bull trout spend their entire life in a single river or stream (State of Montana, http://fwp.mt.gov/wildthings/tande/bullTrout.html). Juveniles use runs, riffles and pocket water but fish >1 year selected deeper pools while resting (Wydoski and Whitney 2003 in IDFG 2005). Migratory fish generally attain weights of 1–7 kg (2–15 lbs). Spawning takes place in headwater and tributary streams for all life history types. Spawning occurs in the fall from late August to December when water temperature is declining from about 3–4 C (38–41 F).

In the vicinity of the proposed project, the bull trout migrate between Lake Coeur d'Alene into the St. Joe River, spawning in the headwaters and rearing to adults in the lake.

A Golder ecologist visited the project area on November 29, 2009. The stretch of the St. Joe River adjacent to the project area, and immediately upstream and downstream includes islands, riffles and runs. Bed material is comprised of cobbles and gravels.

Based on the presence of bull trout, a Biological Assessment will be prepared for the project once the specific removal action is determined.

2.3.6.3 State Species of Concern

Golder submitted a request to the Idaho Department of Fish and Game (IDFG) Conservation Data Center (CDC) requesting a list of reported occurrences of proposed, endangered, threatened, and special status species in the vicinity of the proposed project area. The IDFG CDC sent a response letter and record

search results via e-mail December 2009 (Appendix J). The IDFG CDC record search indicated that the following species were reported in the vicinity of the proposed project area:

Species known to occur within the defined project:

- Bull trout (USFWS threatened)
- Westslope cutthroat trout (Idaho species of concern)

Species which should be considered possible within the defined project area:

- Coeur d'Alene salamander (Idaho species of concern)

Ecological information about these species, and the likelihood of their occurrence or the likelihood for habitat on the proposed project area is described in the following paragraphs.

Westslope cutthroat trout (*Oncorhynchus clarki lewisi*)

The westslope cutthroat trout (*Oncorhynchus clarki lewisi*), listed by the State of Idaho as a species of special concern, migrates upstream in the St. Joe River past St. Maries and into headwaters to spawn, then the juveniles migrate downstream to mature in Lake Coeur d'Alene. Westslope cutthroat trout normally require well–oxygenated water; clean, well–sorted gravels with minimal fine sediments for successful spawning; temperatures <21 C (<70 F), and a complexity of in-stream habitat structure such as large woody debris and overhanging banks for cover.

Adfluvial westslope cutthroat trout spend 1–4 years as juveniles in streams before moving into lakes. If other species are present in the lakes, sestslope cutthroat will use near shore, littoral areas otherwise they will disperse throughout the lake (Wydoski and Whitney 2003 in (IDFG 2005)). Adult fluvial fish overwinter in deeper pools and migrate to tributaries to spawn. Westslope cutthroat trout spawn between March and July when water temperatures are about 10 C (50 F) (IDFG 2005).

The species is known to occur in the reach of the St. Joe River within the defined project area. Spawning habitat for the westslope cutthroat trout potentially occurs in the proposed project area.

Coeur d'Alene salamander (Plethodon idahoensis)

Coeur d'Alene salamanders inhabit stream riparian zones, particularly in seep and springs and fractured rock areas adjacent to streams. Generally, these salamanders are nocturnal coming above ground when the temperature is above 45 degrees Fahrenheit. Coeur d'Alene salamanders are known to eat aquatic insects and other invertebrates, which are also active during the night (Cassirer et. al 1993).

In northern Idaho, Coeur d'Alene salamanders emerge from winter hibernation in late March and are active through April and May. From June until mid-September, Coeur d'Alene salamanders retreat underground to aestivate. A second period of activity continues with September through

early November rains, followed by a period of hibernation that lasts until spring (http://imnh.isu.edu/DIGITALATLAS/bio/amph/urodela/plid/plidfram.htm).

Data provided by the IDFG CDC, indicate there are four known occurrences of Coeur d'Alene salamanders within one mile upstream and downstream of the Site.

2.4 Previous Investigations

The Avery Landing Site has been under investigation since the late 1980s. Figure 2-2 depicts the location of monitoring wells and other historical investigation locations. A list of the most relevant investigation reports are as follows:

- Ecology and Environment, Inc. (E & E), April 10, 2007. Avery Landing Site Site-Specific Sampling Plan, prepared for the U.S. Environmental Protection Agency, Contract Number EP-S7-06-02, TDD 07-03-0004, Seattle, Washington.
- Farallon Consulting, L.L.C. (Farallon), March 17, 2006. Failure Analysis and Preliminary Corrective Action Work Plan, Avery Landing Site, Avery, Idaho.
- Hart Crower, Inc. (Hart Crowser), December 15, 2000. Remediation System Installation and Third Quarter 2000 Performance Report, Avery Landing Recover System, prepared for Potlatch Corporation.
- Hart Crowser, September 5, 2000. Addendum No. 1 for Corrective Action Plan, Avery Landing, Avery, Idaho, prepared for Potlatch Corporation.
- Hart Crowser, August 7, 2000. Corrective Action Plan, Avery Landing Site, Avery, Idaho, prepared for Potlatch Corporation.
- Hart Crowser, August 7, 2000. Site Characterization Report (SCR) and Second Quarter Performance Report – Avery Landing, prepared for Potlatch Corporation.
- Hart Crowser, November, 1994. Laboratory Results for Excavated Soils Avery Landing Recovery System, prepared for Potlatch Corporation.
- Hart Crowser, July 27, 1994. Draft Final Design of Free Product Recovery System (FPRS), Avery Landing, Idaho, prepared for Potlatch Corporation.
- Hart Crowser, December 29, 1993. Results of December 1993 Site Visit and Testing, Avery Landing, prepared for Potlatch Corporation.
- Hart Crowser, December 2, 1993. Proposed Draft Replacement for Free Phase Recovery Completion Section in the Draft Consent Order and Remediation Plan, prepared for Potlatch Corporation.
- Hart Crowser, November 22, 1993. Report of Sampling and Analyses, Avery Landing, prepared for Potlatch Corporation.
- Hart Crowser, October 27, 1989. Site Exploration Report, Avery Landing Avery, Idaho, prepared for Potlatch Corporation.
- Idaho Department of Environmental Quality (IDEQ), May 9, 1991. Preliminary Assessment (PA) Avery Railroad Dump and Roundhouse, Avery. Idaho, prepared for the U. S. Environmental Protection Agency, Region X, Superfund Program Management Section.
- URS Consultants, Inc. (URS), January 19, 1993. Site Inspection Report for the Avery Railroad Dump and Roundhouse Site, CERCLIS ID No. IDD984666313, prepared for the U.S. Environmental Protection Agency, Contract No. 68-W9-0054, Work Assignment No. 54-17-0JZZ, Seattle, Washington.

All of these documents can be found on the CD in Appendix G.

2.5 Previous Removal Actions

2.5.1 1995 Floating Product Capture Trenches

In 1995, a series of three separate, 150-feet-long, free product recovery trenches were installed at the Site parallel to the St. Joe River (Figure 2-3). These trenches were part of a recovery system designed to intercept and remove floating petroleum product referred to as Light Non-Aqueous Phase Liquids (LNAPLs) from Site groundwater. Collectively the trenches are approximately 450 feet in length with four extraction wells, designated on the figure at EW1 through EW4. The trenches were installed below the water table along the down-gradient boundary of the floating LNAPL. Based on a review of a letter documenting the work plan (Hart Crowser May 2, 1994), the recovery trenches were up to 20 feet deep.

Groundwater and LNAPL was pumped from these extraction wells to an oil/water separator located on a concrete pad north of the trenches. LNAPL was skimmed from the water surface and collected into an adjacent 3,000-gallon above-ground storage tank. The groundwater pumping could be operated to induce river water flow toward the trenches and keep any floating LNAPL between the trenches and the river from discharging to the river. After passing through the oil/water separator to remove the LNAPL, the extracted groundwater was discharged to an on-Site infiltration trench located just north of State Highway 50 between Sections 16 and 15 of T45N R5E (see Figure 2-3). This system operated from approximately 1995 through 2000 and recovery of 1,290 gallons of product was reported (Farallon 2006).

2.5.2 2000 Impermeable Vertical Wall along River by Hart Crowser

In 2000, to prevent floating LNAPL from migrating to the river, a containment system consisting of a semi-vertical impermeable barrier (synthetic membrane identify as 30 mil ‘Arctic Liner’) and a series of collection wells were installed along the river bank. See Figure 2-4 for a depiction of the impermeable wall location. Five collection wells (CW1-CW5) were installed on the inland side of the barrier. Plans called for these wells to be 2-3 feet in diameter and 15 feet deep. These wells were used to remove LNAPL that became trapped behind the barrier (Farallon 2006). The recovered floating LNAPL was sent off-Site for recovery or reuse.

Original installation plans required the removal of approximately 10 horizontal feet of existing river bank. Following installation of the barrier, the excavated areas were backfilled with sand, gravel and riprap. The riprap was placed on the river-side of the barrier to hold the liner in place (Hart Crowser August 7, 2000) The bottom elevation of the barrier was designed to, “be sufficient to prevent migration of free product to the river, but not significantly impact the flow of groundwater’ (Hart Crowser, August 7, 2000). Therefore, groundwater was allowed to flow underneath the vertical barrier and to discharge into the river.

The system appears to have worked for a number of years until about 2005 when floating product became visible at times seeping into the river along limited sections of the river bank (Potlatch, 2005).

The source of the product seeps could not be from residual petroleum along river bank soils, because all impacted soils along the river bank were removed and replaced with clean soils. The two possibilities for the LNAPL to escape this impermeable barrier are: (1) tears/breaches in the wall or (2) groundwater levels dropping below the bottom of the wall. It is suspected that the floating product is migrating under the containment barrier rather than through tears (or seam openings) in the barrier materials. If the river level drops below the barrier, LNAPL could migrate beneath the wall and flow directly into the river. This may be the situation where significant obstructions such as concrete foundations or large boulders adversely affected the installation depth of the barrier wall at specific locations.

2.5.3 LNAPL Seep Maintenance

As recommended by the IDEQ in a letter dated January 18, 2002, and because seeps containing floating LNAPL have been observed after the removal actions were completed in 2000, oil absorbent booms have been placed around the LNAPL discharging seeps when the river is not iced to minimize further impacts to the St. Joe River. Currently, the booms are inspected and maintained about once every month during the late summer and fall when oil discharges to the river occur. The booms are subsequently removed from the river in the late fall or early winter prior to the formation of ice on the river.

3.0 EE/CA INVESTIGATION

This section describes the EE/CA field investigation tasks that were conducted in August and September 2009. The field EE/CA investigation was conducted in accordance with the EE/CA Work Plan and the Field Sampling and Analysis Plan (Golder, 2009).

3.1 Soil Investigations

This section describes the EE/CA field soil investigation tasks that were conducted. A series of test pits and soil borings were advanced at pre-determined locations across the Site. The purpose of this sampling effort was to collect additional information about potential petroleum product releases on the western portion of the Site and to delineate the extent of contaminate on the eastern and northern portions of the Site. In addition to the test pits, six treatability test pits were excavated within the known LNAPL Plume area. Analytical data obtained from soil samples collected from the treatability test pits were used to evaluate treatability options. Sampling procedures and nomenclature used are described in detail in the SAP and referenced Golder Technical Procedures for EE/CA field tasks. Before any intrusive work was conducted within the Site boundary, the Site owners were notified of the work schedule and authorization obtained. A public utility locate was performed along Highway 50 and a private locate conducted on the Site before the subsurface investigations began.

3.1.1 Test Pits

A series of eight test pits were excavated at locations across the western portion of the Site. Test pit locations were chosen in areas where investigative data from prior studies do not exist. Three of the test pits were excavated along a former railroad spur (TP-05 throughTP-07). To maximize lateral coverage across the Site, the remaining test pits (TP-01 through TP-04, and TP-08) were spread out within the western/central area. The SAP prescribed the excavation of only 7 test pits, but based on conditions observed during the excavation of TP-01 and the installation of monitoring well GA-01, test pit TP-08 was excavated near the river bank, southwest of TP-01 to try to identify the western extent of free product in the subsurface. Refer to the SAP and Work Plan for a more detailed description of the sampling procedures. Figure 3-1 shows the test pit locations. GPS was used to establish the location of each test pit.

Using an excavator, each test pit was advanced until groundwater was observed. During the excavation of TP-05, refusal was reached at approximately 13 feet bgs, so an additional test pit (TP-05N) was excavated approximately 40 feet east of TP-05. Refusal was reached at 11 feet in this second test pit, so groundwater was not encountered in the vicinity of the TP-05 test pits. Golder collected a minimum of three soil samples from each test pit, one from the surface, middle and bottom. For the purpose of this sampling event, ‘surface’ samples were collected approximately 2.5 feet bgs. Groundwater was encountered at depths ranging from a minimum of 8 feet bgs in TP-04 to a maximum of 18 feet bgs in TP-07. Generally groundwater was observed between 13 and 15 feet bgs. Soils were evaluated for the

potential presence of petroleum products using field screening techniques such as sheen testing, PID reading, and olfactory senses. Pertinent results from the field screening and other observations were documented in the field logs. Copies of the test pit logs are provided in (Appendix A).

Soil sampling procedures and chemical analyses performed are outlined in Section 3.1.1 of the SAP. Each soil sample was designated with a unique number including Golder (G), the test pit identification (i.e. TP-1), the sample depth in feet and the sample collection date. For example GTP-1-2.5-082709 was collected by Golder, from Test Pit 1, at a depth of 2.5 feet bgs, on August 27, 2009.

Following completion, each test pit was back-filled with the excavated materials.

Soils encountered in test pits (TP-01 through TP-04, and TP--08) were interpreted as 6 inches to several feet of topsoil underlain by gravelly sands and gravels. A tree stump was observed at the bottom of TP-1, approximately 13.5 feet bgs. This stump is indicative of the native soil horizon.

In contrast, a layer of topsoil was not found in TP-05 through TP-07. Material within these test pits appeared to be fill comprised of sands, gravel and cobbles. Chunks of concrete were documented in TP-05. Within TP-05, TP-05N and TP-06 wood chips and logs were noted at depths between 6 and 11 feet bgs. Larger logs (up to 30 inches in diameter) were encountered within TP-05N at 11 feet bgs. These logs prevented the excavator from advancing deeper in this location and groundwater was not reached. The excavator re-located approximately 40 feet east from TP-05N and advanced TP-05.

The test pit farthest to the west was TP-07. Approximately 11 feet of fill material consisting of sands and angular gravels were identified in this test pit.

Field screening did not identify any areas of contamination in TP-02, TP-04, TP-05, and TP-07.

3.1.2 Treatability Study Test Pits

A series of six treatability study test pits were excavated within the central portion of the Site, where historic railroad operations were concentrated and where LNAPL has been found in wells during previous investigations. Figure 3-1 shows the treatability test pit locations.

Using an excavator, each test pit advanced approximately 1 to 2 feet below groundwater. Bulk samples of soils impacted by LNAPL were collected from within both the saturated and unsaturated zones. Bulk samples from each treatability study test pit were shipped to ART Engineering in Tampa, Florida. Using these bulk soil samples, ART, under the direction of Golder, conducted a bench-scale soil washing treatability study. Results from this study are presented in Appendix F of this report. ART composited soil samples using the following schedule: Composite #1 (TS-01 and TS-02), Composite #2 (TS-03 and TS-05), and Composite #3 (TS-04 and TS-06). Golder also collected composite soil samples for chemical analysis by Test America. Golder used the following compositing schedule: Composite #1 included soil from test pits TS-01 and TS-04, Composite #2 from TS-02 and TS-03, and Composite #3 from TS-05 and

TS-06. These composite samples were designed to represent the range of TPH concentrations that might be treated. The actual compositing schedule deviated from the Treatability Study Work Plan because the conditions observed in TP-02 and TP-03 were very similar, so they were composited.

Soils encountered in the treatability test pits (TS-01 through TS-06) were generally interpreted as sand, gravelly sands, and gravels. Soil in the upper 10 feet of soil had angular gravel. Rounded gravel was observed in test pits at depths greater than 12 feet bgs. The depth of groundwater ranged from 15 feet bgs in TS-01 to 20 feet bgs in TS-06. A wedge of black soil was observed across the Site at a depth of approximately 2 feet bgs. In TS-01 and TS-02, the initial evidence of LNAPL impacts were observed approximately 8 to 10 feet bgs. In contrast, in TS-04 and TS-06, LNAPL impacted soils were initially encountered approximate 12 feet bgs. Treatability test pit observations for the presence of petroleum contamination included stained soil, petroleum-like odors, and oil-like free product coating soil and floating on the water table.

Due to a greater presence of free product observed in the vadose zone at TS-02, a bulk composite sample of vadose zone soil (from varying depths within the vadose zone) was collected by Golder and submitted to ART Engineering to be included as part of their treatability study. This bulk composite sample was labeled as TS-2U. Golder did not submit an aliquot of soil from TS-2U to Test America for analysis at the time the other composite samples were submitted in August 2009. Rather, this sample was submitted to Test America by ART Engineering at the conclusion of the treatability study in October 2009. Because Golder did not submit the TS-2U sample for analysis, it is not included in Table 3-1. Instead, the analytical results for sample TS-2U are summarized in the treatability study in Appendix F. In the Treatability Study, asphaltic particles were observed in some samples produced by washing sample TS-2U. This sample represents the fill material in the vadose zone in TS-02. The presence of asphaltic particles may be the result of buried roadbed material from previous Highway 50 demolition. At this time, the aerial extent of fill soil containing this asphaltic material is unknown.

3.1.3 Soil Borings

Golder collected subsurface soil samples from the area in the vicinity of the former 500,000 gallon fuel oil tank. Because soils were expected to contain fill materials and cobbles, a Hollow-Stem Auger (HSA) drill rig was used to advance the borings. Five borings (BH1-BH5) were drilled along Highway 50, in the vicinity of the former 500,000 gallon fuel tank. Borings BH-4 and BH-5 were located on the northern side of Highway 50, while the remaining three borings were placed on the southern side.

During drilling, soil samples were collected from the surface, middle and at the groundwater interface using a split-spoon, 2.5 diameter sampler. The surface sample was collected within the first 2.5 feet bgs. Each boring was advanced to groundwater. Groundwater was encountered in each boring at an approximate depth between 14 and 15 feet bgs. Soils were evaluated for the potential presence of petroleum products using field screening techniques such as sheen testing, PID reading, and olfactory

senses. Pertinent results from the field screening and other observations were documented in the field logs. Copies of the boring logs are provided in Appendix A.

Soil sampling procedures and chemical analyses performed are outlined in Section 3.1.1 of the SAP and referenced Golder Technical Procedures. Each soil sample was designated with a unique number including Golder (G), the boring identification (i.e. BH-1), the sample depth in feet and the sample collection date. For example GBH-1-Surf-082809 was collected by Golder, from Bore Hole 1, at the ground surface, on August 28, 2009.

In each of the borings, fill material consisting of very dense angular sandy gravels was encountered from the ground surface down to approximately seven feet bgs. This is the type of material that would have been imported during the construction of Highway 50. No unusual staining or visual evidence of contamination was noted in this fill material.

A foot of blackened soil was encountered in BH-2 and BH-3 at a depth between six and seven feet bgs. There was no visible sheen or PID reading associated with this material. A similar horizon was not encountered in any of the other three borings.

Field screening techniques identified potential petroleum contamination in every one of the borings. In BH-5, located north of Highway 50 nearest to the former fuel tank, a petroleum odor and sheen was observed in soils sampled from 5 feet bgs to the groundwater interface at 15 feet bgs. Across Highway 50 to the south, in an inferred down-gradient location from BH-5, soils collected from BH-3 at 10-11.5 feet bgs displayed a petroleum odor and sheen. LNAPL was observed floating on groundwater recovered from BH-3 as well is in borings BH-1, BH-2, and BH-4.

3.1.4 Monitoring Well Installation

Four monitoring wells were installed at the Site to collect groundwater quality information in the western portion of the Site. Monitoring well construction details are summarized in Table 3-4. Using a HSA rig, soil samples were collected, logged, and field screened for evidence of contamination during the monitoring well installation process. Screening techniques included sheen testing, PID reading, and olfactory senses. Based on the results of this screening, soil samples with evidence of potential contamination were submitted to the laboratory for analysis. Pertinent results from the field screening and other observations were documented in the field logs. Monitoring wells were identified as GA-1 through GA-4 the 'G' indicating **G**older. Wells were installed as outlined in Section 3.1.1 of the SAP and referenced Golder Technical Procedures. Copies of the boring logs and monitoring well construction details are provided in Appendix A and Table 3-3.

Soils observed within GA-3 were different than GA-1, GA-2, and GA-4. At GA-3, native soils were first encountered at approximately 18.5 feet bgs below fill consisting of angular sandy gravel, cobbles, and trace amounts of wood debris. A slight sheen was noted on the groundwater purged from this well. In

contrast, the 7.5 feet of fill material observed in GA-1 was very dense gravelly sand. This fill material was underlain by silty sand.

3.1.5 Soil Analytical Results

Analytical results for soil samples collected in the test pits and borings are shown in Tables 3-1 and 3-2, respectively, and are briefly summarized in the following sections.

3.1.5.1 Test Pits

All soil samples collected from the test pits were a sent to Test America in Spokane, Washington for analysis using the following methods:

- Northwest Total Petroleum Hydrocarbons for diesel and extended range organics (NWTPH-Dx)
- EPA Method 8270C for polynucleated aromatic hydrocarbons (PAHs), including naphthalene, 1-methylnaphthalene, and 2- methylnaphthalene
- EPA Method 8082 for polychlorinated biphenyls (PCBs)
- EPA Method 8260B for Target Compound List (TCL) volatile organic compounds (VOCs);
- EPA Method 8270C for TCL semi-volatile organic compounds (SVOCs)
- EPA Methods 6010C/6020A and 7471B for TAL Metals

Table 3-1 provides a summary of the detections for soil samples collected from the test pits. Diesel and/or heavy oil range petroleum hydrocarbons were detected in samples collected from each of the test pits at concentrations above the PQL. The highest concentrations of heavy oils were detected in TP-1 and TP-6. TP-1 is located near the former roundhouse and TP-6 is on the western portion of the Site. As noted previously, fill material was identified in TP-6. The origin of this fill material is unknown.

PCBs (Aroclor 1260) were detected in the following samples: GTP4-2.5-082709, GTP2-2.5-082709 and GTP3-5-082709 above the PQL. All of these soil samples were collected 2-5 feet bgs, well above the groundwater interface. No other test pit samples had PCBs detected above the PQL.

With the exception of TP-5 and TP-7, carcinogenic PAHs were detected in soil samples collected from all the test pits. Most of these detections were below the PQL. Soil samples obtained from TP-1 at 2.5 feet, 10.5 feet, and 13.5 feet bgs contained concentrations of Benzo(a)pyrene above the screening levels established in the QAPP. Other carcinogenic PAHs in TP-1 samples at concentrations above the screening levels are Benzo(a)anthracene, Dibenzo(a,h)anthracene and Indeno(1,2,3-cd) pyrene.

Non-carcinogenic PAHs were detected in samples collected from TP-1 – TP-7. Naphthalene was the only non-carcinogen detected at a concentration above the established screening level. This was in samples from TP-6. Semi-volatile organic compounds were detected in all of the test pit samples. Some of these detections included PAHs identified above in addition to other semi-volatile compounds.

With the exception of TP-7, volatile organic compounds were detected in samples from each test pit. These included detections above screening levels for benzene, ethylbenzene, methylene chloride, m,p-xylene, and trichloroethene.

With the exception of silver, all of the Target Analyze List (TAL) metals were detected in at least one sample from the test pits. See Table 3-1 for a summary of the detections.

3.1.5.2 Treatability Test Pits

Composite soil samples collected from the treatability study were sent to Test America in Spokane, Washington for analysis using the following methods:

- Northwest Total Petroleum Hydrocarbons for diesel and extended range organics (NWTPH-Dx)
- EPA Method 8270C for PAHs, including naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene
- EPA Method 8082 for polychlorinated biphenyls (PCBs)
- EPA Method 8260B for Target Compound List (TCL) volatile organic compounds (VOCs)
- EPA Method 8270C for TCL semi-volatile organic compounds (SVOCs)
- EPA Methods 6010C/6020A and 7471B for TAL Metals

Table 3-1 provides a summary of the detections for soil samples collected from the treatability test pits. Diesel and heavy oil range petroleum hydrocarbons were detected all of the composite soil samples at concentrations above the PQL. PCBs were detected in two of the samples, TS-Comp-1 and TS-Comp-3. Several semi-volatile and volatile organic compounds were detected in the treatability study test pit samples. Both carcinogenic and non-carcinogenic PAHs were detected in all three treatability study test pit composite samples at concentrations above the laboratory PQL. Results for TS-2U are summarized in the treatability study in Appendix F.

3.1.5.3 Soil Borings

All soil samples collected from the soil borings as well as soils from the monitoring well installations that showed LNAPL impacts were submitted to Test America in Spokane, Washington for analysis using the following methods:

- Northwest Total Petroleum Hydrocarbons for diesel and extended range organics (NWTPH-Dx)
- EPA Method 8270C for polynucleated aromatic hydrocarbons(PAHs), including naphthalene, 1-methylnaphthalene, and 2- methylnaphthalene
- EPA Method 8082 for polychlorinated biphenyls (PCBs)

Table 3-2 provides a summary of the detections for soil samples collected from the borings. Diesel and/or heavy oil range petroleum hydrocarbons were detected in samples collected from each of the borings at concentrations above the PQL. The highest concentrations of diesel and heavy oils were detected in

samples collected from BH-5 at 7.5 feet bgs and BH-4 at 7.5 feet bgs. Both of these bore holes were located on the north side of Highway 50.

PCBs were not detected above the PQL in any of the soil samples collected from the borings.

With the exception of soil samples obtained from BH-1, carcinogenic PAHs were detected in soil samples collected from all the other borings. BH-4 at 7.5 feet bgs was the only sample with a carcinogenic PAH (Benzo(a)pyrene) detected above screening levels. Non-carcinogenic PAHs were detected in samples collected from BH-1 through BH-5 at concentrations above the laboratory PQL.

3.1.5.4 Monitoring Well Soil Samples

Soil samples from the monitoring well installations were only analyzed when field observations (i.e. visual signs, olfactory senses, and PID measurements) indicated LNAPL impacts.

Soil samples were collected from GA-1 (21 feet bgs) and GA-2 (20 feet bgs) because of observations of potential contamination. The soil samples from these wells were submitted to Test America in Spokane, Washington for the following analyses:

- Northwest Total Petroleum Hydrocarbons for diesel and extended range organics (NWTPH-Dx)
- EPA Method 8270C for polynucleated aromatic hydrocarbons(PAHs), including naphthalene, 1-methylnaphthalene, and 2- methylnaphthalene
- EPA Method 8082 for polychlorinated biphenyls (PCBs)

Soil sample results for the monitoring wells are included in Table 3-2. The soil sample results indicated detections of diesel and heavy oil range petroleum products above laboratory PQLs. No other constituents were detected.

3.2 Groundwater Investigation

The hydrogeologic study focused on the groundwater quality directly beneath the Site, and in particular the western portion of the Site where investigation data were absent. A number of monitoring wells installed by EPA and Potlatch currently exist on the eastern portion of the Site (see Figure 2-4). Because no monitoring wells existed on the western portion of the Site prior to the EE/CA, Golder installed a total of four monitoring wells (designated GA-1 through GA-4) along the western half of the Site (see Section 3.1.4 for details). The locations of the monitoring wells that were included in the EE/CA groundwater investigation, including those installed by Golder, are depicted on Figure 3-2.

3.2.1 Monitoring Well Installation

As discussed earlier in this section, four monitoring wells were installed in the western portion of the Site. The beginning of the saturated zone was observed at the time of monitoring well installation to begin at approximately 10 feet bgs in monitoring wells GA-1, GA-2, and GA-4. Because of extensive fill, the depth

to the saturated zone in GA-3 was approximately 18.5 feet bgs at the time of monitoring well installation. Following installation, each well was developed by the driller. A minimum of 55-gallons was pumped from each well and stored in labeled 55-gallon drums on Site. LNAPL was present on groundwater pumped from GA-1. The monitoring wells were not sampled until the aquifer was allowed to stabilize.

3.2.2 Groundwater Hydraulic Gradient Investigation

To better understand the flow of groundwater at the Site, all new and existing monitoring wells were evaluated on September 1, 2009 and November 1 9, 2009 for groundwater level (elevation) changes. The stick-up pipes located throughout the Site were evaluated on September 4 and 9, 2009 for the presence of water and LNAPL. The order in which the monitoring well water levels were measured was based on historical well data. Water levels were measured beginning with the cleanest wells first followed by the wells with a history of floating LNAPL. The order in which Golder wells were evaluated was based on conditions (the presence or absence of LNAPL) observed during the drilling as well as their relative location on the Site. Using an oil/water interface probe, the water level and the LNAPL level (if present) were measured in each well. The procedure for measuring the water level and LNAPL level is discussed in the EE/CA SAP. The water level meter was decontaminated between each well using Alconox and distilled water.

Monitoring wells with floating LNAPL were: GA-1, EMW-04, EMW-06, MW-11 and pipe #1010. A sheen was observed on the water in EW-4. At the time of the September 2009 EE/CA investigation, HC-4 could not be located (the monument was buried by dirt and weeds); however, it was located during the November 2009 groundwater monitoring activities at which time floating LNAPL was present in this well. As a result, HC-4 was not included in the geodetic survey and a reference elevation for that well was not determined. Therefore, it has been omitted from groundwater hydraulic gradient discussions.

Groundwater level measurements are summarized in Table 3-4. Water levels measured in wells with floating LNAPL were corrected for the thickness of the LNAPL present. The correction factor included multiplying the LNAPL thickness in the well by the specific gravity of the LNAPL (estimated to be 0.90), then adding this amount to the elevation of the water level in well (EPA, 1995). In general, the groundwater flow direction observed in September 2009 was to the west-southwest. The results of the groundwater hydraulic gradient investigation are analyzed in Section 4.

3.2.3 Groundwater Quality Sampling

Two groundwater sampling events were proposed for the EE/CA investigation. The first round of groundwater sampling was conducted September 1 to 5, 2009, which provided analytical results for the seasonal low groundwater conditions. The second groundwater sampling event is scheduled for spring 2010 after the bulk of snow melt has occurred; the results of which will be representative of the seasonal high groundwater conditions. The SAP identified that groundwater samples would be collected from the following wells: GA-1 through GA-4, and existing wells DW-01, HC-1R, EMW-04, MW-11, EW-3,

EMW-06, EW-4, and MW-5. A groundwater sample was collected from EMW-05 instead of MW-11, because of the lack of water and large volume of LNAPL observed in MW-11 during the hydraulic gradient investigation. These selected monitoring wells provided aerial coverage of the groundwater impacts on-Site. Groundwater quality sampling activities were conducted in accordance with protocols and procedures specified in the relevant Golder Technical Procedures referenced in the SAP and QAPP.

3.2.4 Drop Tube Installation

Monitoring wells with floating LNAPL were sampled through a dedicated drop tube. Drop tubes were installed in GA-1, EMW-04, EMW-06, and EW-4. Even though LNAPL was not observed in DW-01 or EW-3, the diameter of these wells was so large that a drop tube was required to help guide the sample tubing straight down into the well to the desired sampling depth. The drop tube aided groundwater sampling by protecting the sample collection tube from LNAPL contamination. The drop tube was fabricated by threading together 5-foot lengths of ¾-inch diameter polyvinyl chloride (PVC, schedule 10) well casing. The drop tube was long enough to advance approximately 1.5 feet below the water level (i.e. 1.5 feet below the bottom of the LNAPL layer). Prior to placement inside the well, the bottom of the drop tube was sealed with a piece of tinfoil fixed to the tube by a rubber band. Two stainless steel bolts were placed inside of the drop tube so that they rested on the tinfoil, to cause the tinfoil to create a meniscus. The tinfoil meniscus prevented any LNAPL from entering the drop tube and prevented LNAPL from adhering to the outside of the tinfoil. The drop tube was then lowered into the well until the bottom of the drop tube was at the desired elevation. The drop tube was held in place by securing it to the well casing using duct tape and rope. The tinfoil was punctured with a rod, causing the stainless steel bolt to drop to the bottom of the well. The drop tubes will remain in place until the end of the second groundwater sampling event, after which the drop tubes will be removed.

3.2.5 Groundwater Sample Collection

All wells (with or without LNAPL) were sampled using a peristaltic pump and new, dedicated, HDPE ¼-inch tubing with a cap on one end. The capped tubing was then lowered into the well (or inside of the drop tube) to approximately the center of the water column in the screened interval or 2 feet below the water level (1 foot below the drop tube, if applicable). The cap further prevented LNAPL or a sheen from contacting the sample tubing intake through carry-down. The ¼-inch tubing was connected to a peristaltic pump that was run in reverse flow so that the air pressure blew the cap off of the tubing. Low-flow sampling commenced once the cap was blown off the tubing.

The groundwater monitoring wells were purged at a low-flow rate for sample acquisition, such that water table drawdown is less than 0.3 feet. During well purging, field parameters pH, conductivity, turbidity, dissolved oxygen, and temperature were measured every 5 minutes. The instruments used in the field parameter measurements were field calibrated per the manufacturers' specifications and as described in the QAPP at the beginning of the day. Purging continued until the water quality parameters stabilized, turbidity was less than 5 NTU, and after one well volume was purged. After these three conditions were

met, an unfiltered groundwater sample was collected. A filtered groundwater sample was also collected from each well (except for MW-5 due to low water conditions) after the collection of the unfiltered groundwater sample. The water was filtered using an inline 0.45 micron filter. The filtered samples were submitted to the laboratory, but were archived until unfiltered sample results are reviewed. All field parameter measurements and purge volumes were recorded on Sample Integrity Data Sheets (see Appendix B) and a summary of the field parameter measurements at the time of sample collection is included in Table 3-5. Each sample was given a unique identification number that includes Golder (G), the well number (i.e., MW11 for monitoring well MW-11), the letters FP (Floating Product) behind the monitoring well number, and the sample collection date (i.e. G-MW11FP-011309). Documentation for groundwater samples included bottle labels, Sample Integrity Data Sheets and Chain of Custody Records. Samples were placed on ice in coolers secured with chain of custody seals for transport to the laboratory.

Deviations from the above described activities occurred when sampling MW-5 and DW-01. At the time of groundwater sampling, there was only 1.9 feet of water in MW-5. Because of the low water level and the low well productivity, the well was pumped dry within minutes of the pump being engaged. The well was allowed to recharge and the groundwater sample was collected within 24 hours. Sample collection had to take place over several pumping episodes because of the small volume of water in the well and the number of sample bottles that needed filling for analytical purposes. Additionally, groundwater field measured parameters could not be collected during the pumping at MW-5 because of the limited water in the well. However, field observations indicated that the sample was turbid, opaque in color, but did not have an odor. A filtered sample was not obtained from MW-5. DW-01 is the drinking water well located on the Site. The well pump could not be removed from this well because of the way it was constructed. As a result, the tubing could only be lowered to approximately 25 feet below top of casing (btoc) because of an obstruction. The groundwater sample was collected after purging the well at 460 mL per minute for two hours and after water quality parameters had stabilized. At the time of sample collection the turbidity had stabilized around 100 NTU. Samples were collected in laboratory provided containers.

3.2.6 Groundwater Sample Analysis

All groundwater samples were analyzed at Test America Analytical Services laboratory in Spokane, Washington for the following components:

- Diesel and Heavy Oil Range Total Petroleum Hydrocarbons (NWTHP-Dx extended)
- PAHs (EPA Method 8270 SIM)
- PCBs - GA-1, GA-2, GA-3, and GA-4 wells only (EPA Method 8082- low level)
- Target Analyte List Metals – unfiltered samples only (EPA Method 6010C/0620A Series and EPA Method 7470A)

The filtered groundwater samples were sent to the laboratory and archived until the results of the unfiltered samples were obtained. The filtered water samples from EMW-04, EMW-05, EMW-06, and

EW-3 were analyzed for all dissolved TAL metals because several total metals concentrations exceeded screening levels. The filtered water samples from GA-1, DW-01, GA-4, and GA-3 were analyzed for select dissolved metals because select total metals concentrations exceeded screening levels.

3.2.7 Groundwater Sample Analytical Results

The analytical results are summarized in Table 3-6. Diesel and/or heavy oil were detected in samples collected from HC-1R, EW-3, GA-1, EMW-05, EMW-06, and MW-5. Diesel and/or heavy oil were not detected above the laboratory practical quantitation limit (PQL) in any of the other wells. PCBs were not detected above the PQL in any of the new wells. Carcinogenic PAHs (benzo[a]anthracene and chrysene) were detected in EW-3, EMW-04, GA-1, EMW-05, EMW-06, and MW-5. In general, these detections were estimated values that were below the PQL but above the MDL. Non-carcinogenic PAHs were detected in each of the groundwater samples. A list of the detected PAHs is included in Table 3-6. All of the TAL Metals were detected in at least one of the groundwater samples, except for beryllium, cadmium, and silver. Table 3-6 summarizes the analytical detections in the groundwater samples and compares the results to screening levels. A discussion of the comparison of the results to screening levels is included in Section 4. Analytical laboratory reports are included in Appendix C.

3.2.8 Monitoring Well Floating LNAPL Sampling

Floating LNAPL samples were collected from all of the wells that had measurable product in excess of 0.5-inches based on the estimates made during the hydraulic investigation. As such, LNAPL samples were collected from MW-11 and HC-4. During the hydraulic investigation of the stick-up pipes on-Site, LNAPL was observed in pipe #1010 at the bottom of the pipe, so a sample of the LNAPL was collected for laboratory analysis. The amount of floating LNAPL observed in EMW-04, EMW-06, and GA-1 was not sufficient enough for sample collection. The viscosity of the LNAPL observed in MW-11, pipe #1010, and HC-4 was too high for the LNAPL to be collected using tubing and a pump so a bailer was used instead. Each sample was given a unique identification number that includes Golder (G), the well number (i.e., MW11 for monitoring well MW-11), the letters FP (Floating Product) behind the monitoring well number, and the sample collection date (i.e. G-MW11FP-011309). The samples were collected in appropriate laboratory provided sample containers and analyzed for:

- Diesel and Heavy Oil Range Total Petroleum Hydrocarbons (NWTHP-Dx extended)
- PAHs (EPA Method 8270 SIM)
- PCBs (EPA Method 8082- low level)

Documentation for LNAPL samples included bottle labels, Sample Integrity Data Sheets and Chain of Custody Records. Samples were placed on ice in coolers secured with chain of custody seals for transport to the laboratory.

3.2.8.1 LNAPL Sample Analytical Results

Table 3-7 summarizes the floating LNAPL results. Analytical results for floating LNAPL samples collected from MW-11, pipe #1010, and HC-4 indicated they were comprised of both diesel range organics and heavy oil- likely bunker C oil. PCBs (Aroclor 1260) were detected in the sample collected from MW-11 only. PAHs were detected in all LNAPL samples. All TAL metals were detected in the LNAPL samples, except for antimony, cadmium, and silver.

3.2.9 Groundwater Hydraulic Tests

In addition to collecting water level readings from all on-Site monitoring wells, slug tests were performed in seven of the on-Site monitoring wells and a pressure transducer was installed in EW-4. The following is a discussion of the hydraulic tests that were performed in September 2009.

3.2.9.1 Slug Test

Short-term hydraulic slug tests were performed to approximate the hydraulic conductivity of the aquifer beneath the Site. Ultimately, the results of the slug test were to be used to evaluate the need and implementability for a long-term pump test. Slug tests were performed on seven monitoring wells during the period of September 8 through September 10, 2009. The selection of wells for slug-testing was based on well installation documentation, observed field conditions (water level and absence of floating LNAPL), and aerial representativeness. GA-2, GA-3, and GA-4 were selected for a slug test using a fabricated slug. A slug test was not performed on GA-1 because of the presence of LNAPL. EMW-01, EMW-02, EMW-05, and HC-1R were selected for a slug test, but the fabricated slug could not be used in these wells because of low water levels. Alternatively, the slug test performed at these wells included using a 1-gallon slug of water that was quickly poured into the well. The slug test investigation was conducted in accordance with protocols and procedures specified in the SAP.

The slug test for GA-2, GA-3, and GA-4 was conducted by the following steps:

- Measure water level.
- Lower an AquiStar PT2X Smart Sensor pressure transducer to within one foot of the bottom of the well and record the time of day the pressure transducer was placed in the well.
- Monitor water levels until the aquifer has recovered to static conditions. Connect the pressure transducer to a laptop that has Aqua4Plus software. The aquifer recovery can be monitored in real time using Aqua4Plus software.
- When the aquifer has recovered to static conditions, the slug is inserted to an elevation directly above the water level. The slug is then dropped into the aquifer and the time of day is recorded. The aquifer's increase in head followed by a decrease in the head is then monitored using the Aqua4Plus software (and by manually measuring the water level) until the aquifer has recovered to within 90 % of its static condition. The time that it takes for the aquifer to recover is recorded.

- When the aquifer has recovered to within 90% of static, the slug is quickly removed from the aquifer and the rising head is monitored using the Aqua4Plus software (and manually by measuring the water level) until the aquifer has recovered to static conditions. The time that it takes for the aquifer to recover is recorded. All of the pressure transducer data was downloaded from the data logger for further slug test analysis.

The slug test for EMW-01, EMW-02, EMW-05, and HC-1R was conducted by the following steps:

- Measure water level.
- Lower an AquiStar PT2X Smart Sensor pressure transducer to within one foot of the bottom of the well and record the time of day the pressure transducer was placed in the well.
- Monitor water levels manually until the aquifer has recovered to static conditions. Connect the pressure transducer to a laptop that has Aqua4Plus software. The aquifer recovery can be monitored in real time using Aqua4Plus software.
- When the aquifer has recovered to static conditions, the 1-gallon slug of water is quickly poured into the well and the time of day is recorded. The aquifer's increase in head followed by a decrease in the head is then monitored using the Aqua4Plus software (and by manually measuring the water level) until the aquifer has recovered to within 90 % of its static condition. The time that it takes for the aquifer to recover is recorded.

Hydraulic conductivities were calculated using both the Bouwer-Rice and Hvorslev methods for comparison using Aquifer Test. The curve fit used for both the Hvorslev and Bouwer-Rice were the same for each well and can be viewed in Appendix D. The saturated aquifer thickness for each analysis was assumed to be the amount of water in the well. This was used because many of the water levels were below the top of the screen/filter pack. Saturated aquifer thickness was calculated by subtracting the depth to water from the total well depth (see Table 3-8). Hydraulic conductivities were calculated for the "slug out" process for GA-2 and GA-3. This calculation could not be done for the other wells because a fabricated slug was not used or the hydraulic conductivity could not easily be discerned from the data (GA-4).

Overall the total range in hydraulic conductivities was 0.31 ft/day to 5.16 ft/day, however the h/h_0 versus time graph for HC-1R, with the highest hydraulic conductivity, has a noticeable dip at approximately t_{50} , indicating that the analysis may not be as accurate. Without considering HC-1R, hydraulic conductivity values range from 0.31 ft/day to 3.59 ft/day.

Spatially, the highest hydraulic conductivities occurred in GA-2, GA-3 and GA-4 located on the western end of the Site with the highest hydraulic conductivities measured at GA-2 (3.59 ft/day). The wells located on the eastern end of the property had lower hydraulic conductivities ranging from 0.31 ft/day (EMW-01) to 1.74 ft/day (EMW-02).

The hydraulic conductivity results from slug tests are not very accurate and may in reality vary by up to an order of magnitude from the above referenced results. Long-term pump tests, if needed, would provide more accurate representation of the aquifer's hydraulic conductivity.

3.2.9.2 Long-term Groundwater Level Monitoring

An AquiStar PT2X Smart Sensor pressure transducer was installed in EW-4 on September 10, 2009. The pressure transducer was installed at a depth of 13.5 feet btoc and was programmed to collect data points every hour. After allowing the pressure transducer to equilibrate for 20 minutes, the first reading indicated 0.876 feet of water above the pressure transducer. On November 19, 2009 the water level data was downloaded from the pressure transducer data logger. The raw data is included in Appendix E and a graph of the data is depicted in Figure 3-4. The pressure transducer data was collected to identify if there is a correlation between groundwater and river level fluctuations. This comparison is discussed further in Section 4.

3.3 Near Shore Investigation

The St. Joe River, surface water, and sediments were sampled along the river embankment to assess discharges and impacts from the Site. The river stations are shown on Figure 3-3. There are a total of eight near shore sampling locations labeled RS-1 through RS-8. The following is a discussion of the river station locations:

- RS-1 represents the up-river "background" for comparison to the on-site sampling locations. RS-1 is located up-river of the Bentcik property, on state property. This river station is located along the natural river bank.
- RS-2 is located adjacent to the Bentcik property on state owned property, and was up-stream of the spill booms at the time of sample collection. This river station is near the up-stream end of where the river bank was modified during the installation of the "cut-off" wall in 2000.
- RS-3 is located adjacent to the Bentcik property on state owned property, and is located on the up-stream end of the spill boom. This was the first location where seeping LNAPL was readily noticeable from the banks of the river.
- RS-4 is located adjacent to the Bentcik property on state owned property, and is on the down-stream end of the spill boom where the heaviest LNAPL seep is located.
- RS-5 is located adjacent to the Potlatch property on state owned property, where the wooden dock is located in the river. This river station is downstream from the spill booms.
- RS-6 is located near the down-gradient end of the suspected plume and within the area where the river bank was modified during the installation of the impermeable wall in 2000. This river station is on state owned property.
- RS-7 is located along the natural river bank. This river station is on state owned property.
- RS-8 is at the western end of the Site, along the natural river bank. This river station is on state owned property.

The fall near shore sampling event occurred during September 5 to 10, 2009. All of the river stations were marked by survey stakes and flagging so that the river stations can be easily located for the spring 2010 sampling event. The near shore investigation was conducted by two field personnel for safety reasons due to the proximity to water. The following is a summary of the activities performed during the

fall 2009 near shore investigation. A summary of the results is also included in this Section, but an evaluation of the results is included in Section 4.

3.3.1 Near Shore Sediment Sampling

Sediment sampling occurred on September 7 and 8, 2009. The sediment investigation was conducted in accordance with protocols and procedures specified in the SAP. Two sediment samples were collected from each river station, for a total of 16 sediment samples. One sample was collected at the shoreline (right below the water line) and the second sample was collected approximately three to four feet from the shoreline (in the water) as prescribed by the SAP. Where the banks of the St. Joe River are riprap-lined, the shoreline sediment sample was collected as close to the waterline as practical, wherever the sediment had deposited. In a few locations sediment had deposited between the riprap boulders. The shoreline samples were collected from the surface of the sediment (upper 3-4 inches) using a trowel. All sampling equipment was decontaminated between each sample. Each sediment sample was visually inspected for its petroleum content to identify if any smearing of petroleum occurred during fluctuations of river levels. Differences in petroleum content between the surface and the bottom of the sample collection location were noted. The entire sediment sample was transferred directly into laboratory provided containers for chemical analysis.

The second sample (three to four linear feet from the shoreline) was also collected from the surface of the sediment (upper 3-4 inches) using a trowel. Pockets of sediment between cobbles on the river bottom were targeted for this sample; otherwise, if no sediment pockets were visible, cobbles were overturned in order to collect the sediment residing below. A hand auger was not a viable sample collection method due to the armoring of the river bottom. The sediment was placed directly in the laboratory provided containers. All sampling equipment was decontaminated between each sample.

Documentation for each sample included bottle labels, a Sample Integrity Data Sheets, notes recorded in a field logbook, and Chain of Custody Records. The Sample Integrity Data Sheet was used to document sample collection information and observations. A unique identification number was given to each sediment sample that included Golder (G), the river station number (i.e., RS2 for river station number RS-2), the type of sample it was (SED for sediment), sediment sample location from the shoreline (0 for shoreline samples and 3 for samples collected 3 feet from the shoreline), and the sample collection date. For example: G-RS2SED-3-090909 would be the identification number for the RS-2 sediment sample collected 3 feet from the shoreline on September 9, 2009. Samples were placed on ice in a cooler secured with a chain of custody seal. Sediment samples were analyzed at Test America Analytical Services laboratory in Spokane, Washington for the following components:

- Diesel and Heavy Oil Range Total Petroleum Hydrocarbons (NWTHP-Dx extended)
- PAHs (EPA Method 8270 SIM)
- PCBs (EPA Method 8082- low level)

- TAL Metals (EPA Method 6010C/6020A and 7470A/7471B)
- TCL VOCs (EPA Method 8260B)
- TCL SVOCs (EPA Method 8270C)

After sediment samples were collected Golder returned to each river station where product was observed in sediment off the shoreline to approximate how far from the shoreline the near-surface sediment was impacted by free product. Observations made during this additional investigation and observations made during the initial sediment sampling are discussed below.

3.3.1.1 Sediment Sample Observations

The following is a summary of the pertinent observations that were made during the sediment sample collection. All observations made during sample collection were recorded on Sample Integrity Data Sheets.

RS-1

No indications of impacted sediment were observed at this river station.

RS-2

At the shoreline, pieces of asphalt and charred wood were observed in the sediment. Black oil stained rocks were observed along the shoreline. While the sediment was disturbed during sampling an occasional sheen was observed on the water and there was a petroleum odor. When sediment was disturbed during the collection of the sample three feet from the shoreline, there was a sheen on the water, a sheen in the sample jar, and small flecks of black oil were observed in the sample jar. Some of the cobbles that were overturned approximately 3 feet from the shoreline were coated with black oil on their underside.

RS-3

When collecting the sample at the shoreline, there was a strong petroleum odor and free product was released during the excavation from the sediment and the fabric. A sheen was observed in the sample jar. When collecting the sediment sample four feet from the shoreline, some of the sediment was observed to be covered with free product. There was a strong petroleum odor observed during the sampling and the sample jar had a sheen and free product. Cobbles on the river bottom up to 5.5 feet from the shoreline had black oil covering their underside.

RS-4

Prior to excavation, the shoreline sediment was covered by a layer of orange organic biological growth. During excavation of the shoreline sample, free product was observed seeping from the soil. A strong petroleum odor and a sheen on the soil were observed. During collection of the sample four feet from the

shoreline, the sediment had a slight petroleum odor, there was a sheen in the sample jar, and occasional floating product was released from the soil into the surface water during sample excavation. Cobbles on the river bottom up to 4 feet from the shoreline had black oil covering their underside.

RS-5

Prior to sample excavation, the shoreline sediment had a slight orange hue, possibly caused by biological growth. During the shoreline sample collection a mild petroleum odor was observed in addition to a sheen on the sand, in the sample jar, and on the surface water. Prior to collecting the off-shore sample, a thick orange organic biological growth was observed on top of the river bottom. During sample collection four feet from the shoreline, a strong petroleum odor and a sheen in the sample jars and on surface water were observed. Cobbles on the river bottom up to 2 feet from the shoreline had black oil covering their underside.

RS-6

A sheen was observed on the sediment along the shoreline at this sample location. A sheen was observed on the surface of the river during sample excavation and a sheen was observed in the sample jar. No petroleum odor was observed.

RS-7

No indications of impacted sediment were observed at this river station.

RS-8

No indications of impacted sediment were observed at this river station.

3.3.1.2 Sediment Sample Analytical Results

Table 3-9 provides a summary of the detections in sediment samples. Diesel and/or heavy oil range petroleum hydrocarbons were detected in all sediment samples collected from RS-1, RS-2, RS-3, RS-4, RS-5, and RS-6. The highest concentration of diesel and heavy oil were detected in the RS-4 near shore sample. PCBs (Aroclor 1260) were detected in the RS-1 sample collected four feet off shore. It is suspected that this PCB detection is from an upstream, off-site source. No other samples had PCBs detected above the laboratory PQL. Carcinogenic PAHs were detected in all samples collected from RS-1, RS-2, RS-3, RS-4, RS-5 and in the near shore sample collected from RS-7. The highest concentrations were detected in the RS-4 near-shore and R S-5 sample collected 4 feet off-shore. Non-carcinogenic PAHs were detected in all samples collected from RS-1, RS-2, RS-3, RS-4, and RS-5, and in the near shore samples collected from RS-6 and RS-7. All of the TAL metals were detected in at least one sediment sample. Semi-volatile organic compounds were detected in all of the sediment samples. Some of these detections included PAHs identified above in addition to other semi-volatile compounds.

Volatile organic compounds were detected in all sediment samples. However, the concentrations of the detected volatiles were at or below the laboratory PQL and thus represent trace levels.

3.3.2 Near Shore LNAPL Sampling

LNAPL sampling from the near shore environment occurred on September 5, 2009. The near shore LNAPL investigation was conducted in accordance with protocols and procedures specified in the SAP. Samples were collected where LNAPL was visibly discharging along the river's edge. This included LNAPL observed floating on the surface water and escaping from below the impermeable fabric. LNAPL samples were collected from the following locations

- RS-3 – LNAPL collected from the base of boulders along the shoreline at the upper plant root zone
- RS-3a- LNAPL seeping from under the geotextile, up-stream from RS-3
- RS-4 – floating LNAPL on surface water inside the spill boom
- RS-5 – LNAPL collecting on the wooden dock and from the sediment

The laboratory was instructed to use only the LNAPL for sample analysis, and not any organic material, soil or water that may have also been in the sample jar. The LNAPL was placed directly in the laboratory provided containers. All sampling equipment was decontaminated between each sample.

Documentation for each sample included bottle labels, a Sample Integrity Data Sheets, notes recorded in a field logbook, and Chain of Custody Records. The Sample Integrity Data Sheet was used to document sample collection information and observations. A unique identification number was given to each near shore LNAPL sample that included Golder (G), the river station number (i.e., RS2 for river station number RS-2), the type of sample it was (FP for free product), and the sample collection date. For example: G-RS2FP-090909 would be the identification number for the RS-2 free product sample collected on September 9, 2009. Samples were placed on ice in a cooler secured with a chain of custody seal. LNAPL samples were analyzed at Test America Analytical Services laboratory in Spokane, Washington for the following components:

- Diesel and Heavy Oil Range Total Petroleum Hydrocarbons (NWTHP-Dx extended)
- PAHs (EPA Method 8270 SIM)
- PCBs (EPA Method 8082- low level)
- TAL Metals (EPA Method 6010C/6020A and 7470A/7471B)

3.3.2.1 LNAPL Sample Analytical Results

Table 3-7 summarizes the near shore LNAPL analytical results. All of the LNAPL samples had detections of diesel and heavy oil range petroleum products. The sample with the highest concentrations was from RS-4. None of the near shore LNAPL samples contained PCBs. Each of the LNAPL samples contained select carcinogenic and non-carcinogenic PAHs including benzo(a)anthracene, benzo(a)pyrene,

chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene. All of the TAL metals were detected in the LNAPL samples except antimony, beryllium, cadmium, silver, and thallium.

3.3.3 Near Shore Surface Water Sampling

Surface water sampling was conducted on September 6, 2009. Surface water samples were collected from the eight river stations depicted in Figure 3-3 (the same locations where the sediment samples were collected). Surface water samples were obtained below the river water surface from about the mid-depth. Since the surface water samples were obtained adjacent to the river's edge (~ 1-2 feet from the shore), the depth of the river was shallow and therefore, depth discreet surface water samples were necessary. Unfiltered surface water grab samples were collected directly from the river from locations where there was no visible floating LNAPL present by filling a laboratory cleaned glass container, the contents of which were then transferred into the laboratory provided containers. Filtered surface water samples were also collected at each river station by using dedicated HDPE ¼-inch tubing, a dedicated inline 0.45-micron filter, and a peristaltic pump by filtering water collected in a laboratory cleaned glass container into laboratory provided containers with appropriate preservatives. Filtered surface water samples were collected so that the results could be compared to aquatic water quality standards. Water quality parameters (temperature, pH, conductivity, dissolved oxygen, and turbidity) were also monitored at each river station where a sample was collected. The water quality parameters were recorded on a Sample Integrity Data Sheet and a summary of the parameters is provided in Table 3-5.

Documentation for each sample included bottle labels, a Sample Integrity Data Sheets, notes recorded in a field logbook, and Chain of Custody Records. The Sample Integrity Data Sheet was used to document sample collection information and observations. A unique identification number was given to each surface water sample that included Golder (G), the river station number (i.e., RS3 for river station number RS-3), the type of sample it was (SW for surface water), and the sample collection date. For example: G-RS3SW-090909 would be the identification number for the RS-3 surface water sample collected on September 9, 2009. Samples were placed on ice in a cooler secured with a chain of custody seal. Surface water samples were analyzed at Test America Analytical Services laboratory in Spokane, Washington for the following components:

- Diesel and Heavy Oil Range Total Petroleum Hydrocarbons (NWTHP-Dx extended)
- PAHs (EPA Method 8270 SIM)
- PCBs (EPA Method 8082- low level)
- TAL Metals (EPA Method 6010C/6020A and 7470A/7471B)

3.3.3.1 Surface Water Sample Observations

The following is a brief discussion of pertinent observations made during surface water sample collection. All observations made during sample collection were recorded on Sample Integrity Data Sheets.

RS-1

There were no visual or olfactory indications of impacted surface water at this location.

RS-2

There was a slight petroleum odor at the time of sample collection. Black oil stained rocks and a slight petroleum sheen were observed in the vicinity of the sample.

RS-3

The surface water sample was collected from the upstream end of the spill boom. There was a strong petroleum odor at the time of sample collection. A large petroleum sheen was observed on the water. Small flecks of thin, brown LNAPL were observed seeping from under the shoreline boulders at this sample location.

RS-4

Sample was collected from the downstream end of the spill boom, where the largest oil seep was located. Free product was moved out of the way when the sample was collected, but an oil sheen was observed on the water at the time of sample collection. There was a petroleum odor observed.

RS-5

The sample was collected at the northwest corner of the wooden dock at a location where all of the rocks on the bed of the river are covered by an orange organic biological growth. A small sheen was observed on the water upstream of the sampling location. The sample contained a few pieces of orange organic biological material.

RS-6

The surface water sample was collected from an area of the river near RS-6 where a sheen was on the water and oil coated pine needles and leaves were observed along the shoreline.

RS-7

There were no visual or olfactory indications of impacted surface water at this location.

RS-8

There were no visual or olfactory indications of impacted surface water at this location.

3.3.3.2 Surface Water Sample Analytical Results

Table 3-10 summarizes the surface water sample detections. Diesel and heavy oil range petroleum products were not detected above the laboratory PQL in any of the surface water samples. No PCBs were detected above the laboratory PQL in any of the surface water samples. Carcinogenic PAHs (benzo[a]anthracene and chrysene) were only detected in the sample collected from RS-4. Non-carcinogenic PAHs were detected in all surface water samples. TAL metals were detected in all of the surface water samples. The only metals that were not detected included aluminum, antimony, beryllium, cadmium, cobalt, lead, selenium, silver, and zinc.

3.3.4 Stream Gauging

The St. Joe River is expected to influence the flow of Site groundwater based on antecedent infiltration and river stage. Groundwater levels will be compared over time to changes in the St. Joe River to better understand the influence various river stages have on Site groundwater flow patterns. A temporary station was installed on-Site near RS-2 on the St. Joe River for measurements of river water levels. The water level data collected from the monitoring wells and the St. Joe River can be used to understand changes in groundwater flow patters during different seasons and during changes in the stage of the river.

A stream gauge was installed in the St. Joe River on September 9, 2009. Figure 3-3 depicts the location of the stream gauge. The 4-inch wide graduated stream gauge made from an iron frame coated with backed enamel was mounted to a 2x6-inch board that was bolted to the boulders in the river. The bottom of the gauge rests on the bottom of the river bed. The graduations on the stream gauge are marked at every foot, tenth of a foot, and 0.02 feet. The stream gauge is 8 feet in height in order to be adequate in length for the fluctuations in river levels throughout the year. The top of the stream gauge (at the 8 foot designation) was surveyed in order to tie the river levels observed on the staff gauge to elevations above mean sea level. The staff gauge was removed on December 6, 2009 due to the river beginning to freeze and will be re-installed when the river ice melts in the spring. The stream gauging station was checked on a weekly basis from October to December 2009. Table 3-11 summarizes the river level measurements made to date.

Figure 3-5 displays two hydrographs. One hydrograph is the data collected by the pressure transducer installed in EW-4 and the second hydrograph is the data collected at the USGS Calder, Idaho gauging station. The Calder gauging station is located approximately 23 miles downriver from the Site. The purpose of this graph is to demonstrate that the fluctuations observed in EW-4 are similar to the fluctuating river levels. Indeed, Figure 3-5 illustrates the linkage between groundwater and surface water. When groundwater levels in EW-4 have increased, so too have the river levels at the Calder gauge. Similarly, when groundwater levels decline in EW-4, river levels decline at the Calder gauge.

The stream gauge measurements collected periodically since September 2009 and the data point collected at the Calder gauge at the same time were compared and the correlation was calculated. The

agreement and the correlation between the stream gauge and the Calder gauge results are excellent, with a linear regression correlation coefficient (r) of 0.93. Using a linear regression analysis on the data, results in a linear "best fit" line between the data sets. The slope for that correlation was 1.41 and the regression y-intercept was -1288.47. The slope and y-intercept define the "best fit" line correlating the data sets. Since we do not have a stream gauge monitoring river fluctuations in real time, the slope and y-intercept from the above correlation coupled with the data from the Calder gauge can be used to estimate river levels for the Site. Figure 3-6 depicts this transformed river level data for the Site, compared to the Calder gauge river levels, the manual stream gauge measurements for the Site, and the EW-4 pressure transducer data. Figure 3-6 illustrates the relationship between the groundwater level fluctuation and river level fluctuation. Although the relative difference in elevation of the groundwater and the river level changes throughout the event depicted in Figure 3-6, the peaks and valleys in the two data sets are mirrored.

3.4 Surveying and Geodetic Survey

A geodetic survey was conducted to identify all of the EE/CA investigation locations. This data is included in Appendix E. This included locating the test pits, borings, monitoring wells, historical stick-up pipes, river stations, and the stream gauge. The position of all test pits and river stations were field-located using a Global Positioning System (GPS) and were marked by Golder personnel in a manner that does not interfere with Site operations. Each test pit and river station location was marked with a survey stake and flagging. The test pits and river stations were the only investigation locations where a certified surveyor was not used.

Boreholes BH-1 through BH-5 were marked by Golder using a survey stake and flagging as well as a flush mounted steel plate marker. Monitoring wells were marked by Golder using a survey stake and flagging. Additionally, Golder marked the measuring point (typically the north side of the well casing) to be surveyed with a black marker to ensure the appropriate measuring point was surveyed. Rim Rock Consulting, a certified professional land surveyor licensed in the State of Idaho, was used to survey for the geodetic X, Y, and Z coordinates of boring locations, monitoring wells, historical stick-up pipes, and the stream gauge. Monitoring wells, stick-up pipes, and the stream gauge were surveyed for elevation (Z-coordinate) to third order accuracy and precision. Elevation surveys have an accuracy and precision of at least 0.02 foot for water elevation measurement. Upon review of the survey data by Golder it was determined the z coordinate (elevation) surveyed for EMW-06 was incorrect. The survey reviewed their field notes and indicated that the top of casing elevation for EMW-06 required a +3.73 foot correction.

HC-4 could not be located during the September 2009 EE/CA investigation activities. As such, HC-4 was not included in the geodetic survey so its elevation is unknown. HC-4 was found during the November 2009 reconnaissance. The approximate location of HC-4, based on historical data and our November reconnaissance, was plotted on Golder's figures.

3.5 Quality Assurance/Quality Control

Golder performed a variety of quality control measures during the sample collection and sample analysis process in order to have confidence in the results that were being provided and to achieve data quality objectives. The following is a summary of the results of the quality control program.

3.5.1 Field Quality Control

3.5.1.1 Field Duplicate Sample Results

Quality control duplicate samples were collected in the field and the results are summarized in Table 3-12. One duplicate was collected for approximately every 20 samples submitted to the laboratory for analysis, for a total of one duplicate soil sample, one duplicate sediment sample, one duplicate groundwater sample, and one duplicate surface water sample. The duplicate samples were collected from the same sampling location as the parent sample using the same equipment and sampling technique. Duplicate samples received a unique sample identification number and were analyzed independently as an indication of gross errors in sampling techniques. Duplicate samples were analyzed by Test America. For the soil and water samples, the parent sample results and the duplicate sample results were very similar, and indicated good comparability. Volatile organic compounds and TAL metals had similar results in the duplicate and parent sample. The variability with the duplicate sample can be attributed to the variable nature of sediment.

3.5.1.2 Field Split Sample Results

One split sample was collected for approximately every 20 samples, for a total of one split sample for each media that was sampled (sediment, soil, groundwater, and surface water- except for LNAPL). The split samples were collected from the same sampling location as the parent and duplicate sample using the same equipment and sampling technique. Split samples received a unique sample identification number and were analyzed independently by a second laboratory as an indication of gross errors in sampling and analytical techniques. Split samples were analyzed by Analytical Resources, Inc. of Tukwila, Washington and are summarized in Table 3-12. The arsenic concentration for the G-GA3S-090309 (groundwater sample), was more than twice the concentration detected in the parent and duplicate samples. Additionally, the semi-volatile and volatile reporting limits for the split samples were higher in the samples analyzed by Analytical Resources, Inc., which lead to low level detections in the parent samples and non-detects in the splits. But in general both of the water samples (groundwater and surface water), the parent sample results and the split sample results were fairly similar, and indicated good comparability. There was some variability between the split soil and sediment sample versus the associated parent and duplicate samples, but for the most part, there was good correlation between all of the results. Variability with split samples can be attributed to the heterogeneity of soil samples as well as the variability that arises between analytical laboratories due to analytical procedures and instrumentation. However, the variability observed between the split, duplicate, and parent soil samples were not out of range of what was expected.

3.5.1.3 Equipment Blanks

3.5.1.3.1 Water Samples

Equipment blanks are used as a check on possible contamination originating from container preparation methods, sampling equipment, shipment, handling, storage, preservatives or site conditions. One water equipment blank was collected after sampling activities were completed at EMW-06. The equipment blank was collected using laboratory-provided deionized water. The field blank was given a unique sample identification number and was analyzed by Test America (G-EB-090509). There were trace level detections of several PAHs, but these were also detected in the laboratory method blank (see discussion in Section 3.6), so the validity of these detections is questionable. Copper and nickel were also detected but at trace level concentrations. The analytical results are summarized in Table 3-12.

3.5.1.3.2 Sediment Samples

Equipment blanks were used as a check on possible contamination originating from container preparation methods, shipment, handling, storage, preservatives or site conditions. Equipment blanks were also collected to check the decontamination of non-dedicated field equipment used to collect sediment samples. One sediment field blank was collected (G-EB-090709). There were trace level detections of several PAHs, but these were also detected in the laboratory method blank (see discussion in Section 3.6), so the validity of these detections is questionable. Chromium, copper, vanadium, and zinc were also detected but at trace level concentrations. The analytical results are summarized in Table 3-12.

3.5.2 Laboratory Quality Assurance/Quality Control & Data Validation

This section reports the data quality evaluation performed on the sample data generated for the Avery Landing / Potlatch EE/CA investigations. Data validation is a major part of ensuring the quality of data for decision-making purposes. The process used for evaluating data is outlined in the QAPP.

Sample handling and laboratory analyses were evaluated during the validation process. Golder Associates field crews collected samples in accordance with Golder Technical Procedures and criteria established in the QAPP. Laboratory analyses were performed by Test America of Spokane, Washington, with selected analytical sets performed at the Test America, Tacoma facility. Split samples were sent to ARI Laboratory of Tukwila, WA. Each laboratory utilizes appropriate analytical methodology including the EPA SW-846 manual of “Test Methods for Evaluating Solid Wastes” (EPA, 1986), or the Environmental Monitoring Systems Laboratory (EPA, 1994) manual for drinking water tests, or Washington State Department of Ecology guidance for petroleum hydrocarbons (Ecology, 1997).

Data were evaluated using “U.S. EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review” (EPA, 2007) and “U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review” (EPA, 2004a). Criteria for precision, accuracy, representativeness, completeness, and comparability (PARCC parameters) ensure that the data was systematically evaluated. Certain sample results have been qualified due to sample handling or

laboratory testing deficiencies. Data qualifiers applied can be found on the data validation summary checklists included with this data validation appendix, and on the data tables included with this EE/CA investigation report.

Precision was determined in accordance with data validation guidelines for select samples tested in replicate fashion or for samples targeted for duplicate or split laboratory analysis as presented on chain of custody documentation. Accuracy was determined during the data validation process by review and comparison of calibration standards and control standards as appropriate to the analytical methodology. Data representativeness was achieved by the determination of specific sampling locations as presented in the SAP and determinations made in the field for collection of sample materials appropriate for this investigation. Objectives for completeness for this investigation require that a goal of 90% of the total number of requested determinations be valid. Reporting requirements and units specified in the US EPA Functional Guidelines and other applicable reference methods were used to ensure comparability of data. These objectives were met with only minor exceptions as outlined in the following discussion.

3.5.2.1 Laboratory Sample Receipt Quality Control

3.5.2.1.1 Sample Handling and Custody Requirements

Custody of samples being sent off site for analysis were controlled and documented in accordance with Golder Associates technical procedure TP-1.2-23, "Chain-of-Custody." Chain-of-Custody forms act as a means of specifying the analysis to be performed by the laboratory for each individual sample. Samples received at the laboratory met the conditions necessary to ensure sample integrity, with the exception of the following.

3.5.2.1.2 Analytical Holding Time

Groundwater - Holding times were met, with the exception of the re-analysis of groundwater sample G-GA1-090509 in SDG #SSI0032 for petroleum (NWTPH-Dx).

Surface Water - Holding times were met.

LNAPL matrix - Holding times were met.

Sediment - Holding times were met with the exception of the volatile trip blank associated with the sediment samples in SDG #SSI0049.

Soil Borings - Holding times were met with the exception of volatile analysis for a trip blank and petroleum, and PAH analyses for soil samples G-GAI-21, G-GA3-20, G-D2, and G-GA-D in SDG #SSI0046. Hold times were exceeded for these samples because the samples were received by the laboratory for analysis after the extraction hold time had elapsed by one day. Extractions were performed one day late on the samples which were analyzed a few days later, well within the analytical holding time.

Soil Test Pits – Holding times were met.

3.5.2.1.3 Sample Temperature Receipt

Samples submitted on multiple dates were received at the laboratory meeting the 4 degree Celcius +/- 2 degree industry standard. Therefore, qualification is not applied.

3.5.2.2 Laboratory Quality Control

Internal laboratory quality control checks were performed in accordance with the US EPA Contract Laboratory Program or the specified analytical method. Evaluation criteria were interpreted using EPA guidance documents in conjunction with an understanding of the intended use of the data and best professional judgment.

The analytical laboratory reduced and reported data in accordance with the governing protocol or the specified analytical method, as applicable. Data packages included, a report summarizing the results of the analyses, sample identification, sampling and analysis dates, reduced analytical data, data outliers, laboratory QC recovery percentages, quality control check data, equipment calibration data, and documentation of any nonconformance. Data packages were reviewed and signed by the Laboratory Manager or a Laboratory project representative prior to submittal to Golder. There were no deficiencies in the level or overall quality of the data packages.

3.5.2.2.1 Calibration / Instrument Performance Monitoring

Compliance requirements for satisfactory instrument calibration and performance monitoring were evaluated. Initial calibration verification (ICV) demonstrates that the method used is capable of acceptable quantitative and qualitative performance before proceeding with QC and sample analysis. Continuing calibration verification (CCV) demonstrates that the method is capable of performance on a continuing basis during and including sample and QC analyses. Goals for calibration monitoring were met, with the exceptions noted below.

Groundwater – Continuing calibration associated with the ARI Laboratory PAH-SIM analysis (SDG PN-10) was out of limit, qualifying benzo(g,h.i)perylene in sample G-GA3S-090309 as estimated. Continuing calibration associated with PCB aroclors A-1221, A-1232, A-1242, A-1248, and A-1254 were out of limit, qualifying associated samples G-GA2, G-GA4, G-DW01, G-GA3, G-GA3D, and G-MW5 in SDG #SSI0028 as estimated (J/UJ).

Surface Water – ICV and CCV validation guidelines were met.

LNAPL matrix - ICV and CCV validation guidelines were met.

Sediment - ICV and CCV validation guidelines were met.

Soil Borings - ICV and CCV validation guidelines were met.

Soil Test Pits – ICV and CCV validation guidelines were met.

3.5.2.2.2 System Monitoring

System monitoring serves as a monitor for specific portions of the overall performance of the analytical method. GC and GC/MS method performance on individual samples is established by means of spiking system monitoring compounds (SMC; also know as surrogates), and internal standards that are added just prior to analyses. Performance criteria ensure that instrument sensitivity and responses are stable throughout the analysis on a sample by sample basis. Goals for system monitoring were met, with the exceptions noted below.

Groundwater - System monitoring compounds were added to all samples and associated QC as required. Goals for recovery of SMC were met.

Surface Water - System monitoring compounds were added to all samples and associated QC as required. Goals for recovery of SMC were met.

LNAPL matrix - System monitoring compounds were added to all samples and associated QC as required. Goals for recovery of SMC were met, with the exception of PCB analysis for G-P1010FP, G-RS5FP, G-RS4FP, and G-RS3FP in SDG #SSI0032. Recovery of internal standards was out of limits for PAH-SIM analysis in samples G-RS5FP, and G-RS4FP. Associated results are qualified as estimated (J/UJ).

Sediment - System monitoring compounds were added to all samples and associated QC as required. Goals for recovery of SMC were met, with the exception of volatile analysis surrogates associated with samples G-RS2SED-0-090709, G-RS5DSED-0-090709, and G-RS4SED-0-090709. Associated detects are qualified as estimated (J). Recovery of internal standards was out of limits for PAH-SIM analysis in samples G-RS1SED-4-090709, G-RS2SED-3-090709, G-RS6SED-3-090809, G-RS3SED-4-090809, G-RS3SED-0-090809, and G-RS4SED-0-090809 in SDG #SSI0049. Associated detects are qualified as estimated (J) and non-detect results are qualified as unusable (rejected, R).

Soil Borings – System monitoring compounds were added to all samples and associated QC as required. Goals for recovery of SMC were met with the exception of PAH-SIM analysis of samples G-BH5-7.5-082709, and G-BH5-15-082709 in SDG #SSH0166. Associated results are qualified as estimated (J/UJ).

Soil Test Pits – System monitoring compounds were added to all samples and associated QC as required. Goals for recovery of SMC were met, with the exception of petroleum analysis associated with results for sample GTP5-11-082809, PCB analysis associated with sample GTP5-3.0-082709, and volatile analysis associated with sample GTP1-10.5-082709 in SDG #SSH0168. Associated results are qualified as estimated (J/UJ). Recovery of internal standards was out of limits for PAH-SIM analysis in

samples GTP1-13.5-082709, GTP6-10-082809, and TS-COMP-3 in SDG #SSH0168. Associated detects are qualified as estimated (J) and non-detect results are qualified as unusable (rejected, R).

3.5.2.2.3 Accuracy

Analytical accuracy was assessed by evaluating matrix spike (MS/MSD) recoveries, laboratory control sample (LCS/LCSD) analyses and calibration verification (QCS) standards. Individual recovery for select MS/MSD, LCS/ LCSD, and QCS data is retained in the project file data validation records, and all laboratory deliverable records. Goals for accuracy were met, with the exceptions noted below.

Groundwater – Goals for accuracy were met.

Surface Water - Goals for accuracy were met.

LNAPL matrix - Goals for accuracy were met, with the exception of LCS associated with metal analytes aluminum, iron, magnesium, and potassium, and MS recovery for copper affecting sample G-MW11FP-090109 in SDG #SSI0028. Associated results are qualified as estimated (J/UJ).

Sediment - Goals for accuracy were met, with the exception of the laboratory control sample associated with semi-volatile analytes 1,3-dichlorobenzene, 2-nitrophenol, hexachlorocyclopentadiene, and 2,4-dinitrophenol in SDG #SSI0049. All associated sample results are non-detect and are qualified as estimated (UJ).

Soil Borings - Goals for accuracy were met.

Soil Test Pits - Goals for accuracy were met with the exception of the MS associated with PAH-SIM analyte fluorene, affecting sample TS-COMP-3; the PCB MS results associated with aroclor 1016 and 1260 affecting sample GTP3-13.5-082709; and the LCS for semi-volatile analytes n-nitrosodiphenylamine and carbozole affecting samples GTP1-10.5-082709, GTP3-3.5-082709, GTP4-2.5-082709, GTP4-8.0-082709, GTP5-3.0-082709, GTP5-7.0-082709, GTP6-2.5-082809, GTP6-17-082809 in SDG #SSH0168. LCS recovery was out-of-limit for sodium for all samples in SDG #SSH0168. Associated results are qualified as estimated (J/UJ).

3.5.2.2.4 Precision

Analytical precision was assessed primarily by evaluating relative percent difference between MS/MSD, LCS/LCSD, and laboratory duplicates and serial dilutions. Field duplicates are also assessed for precision between identically prepared samples in the field for blind laboratory analysis, and for split analysis, which was presented earlier in Section 3.5.1. Individual duplicate precision data is retained in the project file data validation records and laboratory deliverable records. Goals for precision were met with exceptions as noted below.

Groundwater – Duplicate precision goals were met, with the exception of out of limit RPD between LCS/ LCSD pair associated with PAH-SIM analytes naphthalene, and 2-methylnaphthalene affecting sample G-GA3S-090309 (ARI Laboratory SDG #PN-10). Associated results are qualified as estimated (J/UJ).

Surface Water - Duplicate precision goals were met.

LNAPL matrix - Duplicate precision goals were met, with the exception of out-of-limit serial dilution percent difference for nickel, vanadium, and chromium affecting sample G-MW11FP-090109 in SDG #SSI0028. Associated detects are qualified as estimated (J).

Sediment - Duplicate precision goals were met, with the exception of laboratory duplicate out-of-limit RPD for vanadium associated with sample G-EB-090709 and out-of-limit serial dilution percent difference for iron associated with sample G-RS6SED-0-090809 in SDG #SSI0049. Associated detects are qualified as estimated (J).

Soil Borings - Duplicate precision goals were met.

Soil Test Pits - Duplicate precision goals were met, with the exception of out-of-limit serial dilution percent difference for iron, aluminum, cobalt, and zinc associated with sample GTP1-10.5-082709, and iron, magnesium, aluminum, copper, nickel, and zinc associated with sample GTP6-17-082809 in SDG #SSH0168. Associated detects are qualified as estimated (J).

3.5.2.2.5 Laboratory Blanks

Laboratory blanks include method blanks, and rinse blanks to ensure that samples are not affected by cross contamination during the analytical process. The laboratory blanks exhibited no cross contamination, with exceptions as noted below. Protocol for qualification of samples associated with blank contaminants is to raise the level of detection to the reporting limit, or to raise the reporting limit to the value detected in the blank and apply a “U” qualifier. Therefore, the noted samples affected are distinct from the less than (‘<’) values, but also represent a non-detect value at the reporting limit provided on the Avery Landing Data Tables. Individual blank data is retained in the project file data validation records and laboratory deliverable records.

Groundwater – Laboratory method blanks were target analyte free, with the exception of; PAH-SIM analysis method blank associated with samples G-HC1R-090409, G-EW3-090409, G-EW4-090409, G-EMW04-090409, G-GA1-090509, and G-EMW05-090509 in SDG #SSI0032; PAH-SIM analysis method blank associated with samples G-GA2, G-GA4, G-DW01, G-GA3, G-GA3D, and G-MW5 in SDG #SSI0028; and metal analytes thallium, magnesium, and sodium associated with samples G-GA2, G-GA4, G-DW01, G-GA3, G-GA3D, and G-MW5 in SDG #SSI0028.

Surface Water - Laboratory method blanks were target analyte free with the exception of; PAH-SIM analysis method blank associated with samples G-RS2SW-090609, G-RS3SW-090609, G-RS3DSW-090609, and G-RS4SW-090609 in SDG #SSI0032;

LNAPL matrix - Laboratory method blanks were target analyte free, with the exception of magnesium and thallium associated with metals analysis on all LNAPL samples (G-P1010FP, G-RS5FP, G-RS4FP, G-RS3FP, and G-RS3aFP) in SDG #SSI0032.

Sediment - Laboratory method blanks were target analyte free with the exception of; volatile analytes benzene, toluene, xylenes, chlorobenzene, 1,2,4-trichlorobenzene, 1,2,3-trichlorobenzene, and naphthalene in SDG #SSI0049; semi-volatile analytes diethylphthalate, and di-n-butylphthalate in SDG #SSI0049; and metal analytes cadmium, selenium, and thallium in SDG #SSI0049.

Soil Borings - Laboratory method blanks were target analyte free.

Soil Test Pits - Laboratory method blanks were target analyte free with the exception of cadmium and thallium associated with metals analysis on select samples in SDG #SSH0168; Volatile results for methylene chloride in multiple samples in SDG #SSH0168; Semi-volatile results for diethylphthalate, di-n-butylphthalate, and di-n-octylphthalate for multiple samples in SDG #SSH0168.

3.5.2.3 Data Validation And Usability

Golder assessed the validated data by comparing validated data results to the Objectives for Measurement as detailed in QAPP. The data are acceptable for their intended use, with the exception of those results that were rejected as denoted by an 'R' qualifier as presented in the Avery Landing Data Tables. The data completeness is greater than 90% and meets QA/QC goals outlined in the QAPP.

4.0 NATURE & EXTENT OF POTENTIAL CONTAMINANTS

All known and suspected sources of potential contamination identified in the previous investigations at the Site have been characterized and interim remedial actions were implemented in 1995 and 2000. Historical data collected by Ecology And Environment, Inc. (E & E) and Hart Crowser are summarized in historical reports, including E & E's July 31, 2007 Removal Assessment Report, copies of which are included on a CD in Appendix G. The results of the EE/CA investigation and analytical results of sampled media were presented in Section 3 of this report. The following Section identifies the contaminants of potential concern (COPC) as determined by results of the previous investigations and the EE/CA investigation, the extent of those COPCs, and discusses the nature of the COPCs. Results of the EE/CA are compared in this Section to conservative screening levels that were set forth in the QAPP. Some of the screening levels have been modified since production of the QAPP because of new guidance documents issued by the Idaho Department of Environmental Quality (IDEQ). Specifically, IDEQ suspended the use of screening levels for2-methylnaphthalene; 1,2,4-trimethylbenzene; and 1,3,5-trimethylbenzene (IDEQ, http://www.deq.idaho.gov/Applications/Brownfields/index.cfm?site=risk.htm). Additional screening levels that were used included the Washington State Model Toxics Control Act (MTCA) Method A screening level for diesel and heavy oil was used as a surrogate because Idaho does not have a standard for these constituents. The results of this comparison with conservative screening levels will help determine the COPCs that will be further evaluated through a comparison to human health and ecological risk levels, ultimately to define the contaminants of concern (COCs) for the Site.

4.1 Extent of Soil Impacts

4.1.1 Historical Soil Sample Results

Observations during boring and monitoring well drilling by E & E in 2007 indicated hydrocarbon odor beginning in most borings at approximately 5-7 feet bgs. Free product was observed on the east side of the property (EMW-02) at approximately 7-9 feet bgs. Free product was observed in most borings and monitoring wells west of EMW-02, but at increasing depths. For example, oily product was observed on soil at ESB-04 from 7-9 feet bgs and on drilling tools at EMW-04 at 13-17 feet bgs. The increase in depth below ground surface of observed free product may be related to the direction of groundwater flow and the nature of mobility of the free product through the fill and native soils (see the physical processes discussion later in this section). Historical soil samples results from E & E in 2007 indicated PAHs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, naphthalene, 1-Methylnaphthalene, and 2-Methylnaphthalene] and several metals in excess of Idaho and EPA screening levels. These exceedances were in samples collected from the surface and sub-surface. Diesel and heavy oil range petroleum products were detected in soil samples in excess of the MTCA Method A screening levels. These exceedances were in samples collected from the surface and sub-surface. PCBs and volatile organic compounds were detected in soil samples (surface and sub-surface soils), but not above screening levels.

The Hart Crowser and E & E data indicated a free product plume beginning underneath Highway 50 at the east end of the Site and extending south to the river banks and west across the Site past ESB-07 and EMW-04, but not as far as EMW-03. The plume and the referenced historical borings and wells are depicted on figures included in the July 31, 2007 report. The plume delineations were based on observations of free product in test pits and soil borings and soil sample analytical results. The difference between the plume delineation made by Hart Crowser in 2000 versus E & E in 2007 is that the plume may have grown larger by 2007 and may have extended further down-gradient to the west and southwest.

4.1.2 Test Pits

4.1.2.1 Treatability Study Test Pits

Test pits labeled as "TS" on Figure 3-1 were excavated within the suspected LNAPL plume as part of the Treatability Study. Observations made during the excavation of the treatability study test pits indicated a wedge of black stained soil in TS-01 and TS-02 at 2-4 feet bgs. This wedge of black stained soil at approximately 2 feet bgs was observed across the Site. A petroleum like odor was observed in TS-01 and TS-02 at approximately 8-10 feet bgs. Below 11 feet bgs in TS-01 and TS-02, the soil appeared stained. Oily free product coated gravel was observed at 14' bgs in TS-01. As the test pit excavations moved west across the Site, the location of the zone of impacted soil increased in depth below ground surface. For example, at TS-03 a petroleum-like odor was observed at 10 feet bgs and oily-like product coated soil from 14.5 feet bgs to the bottom of the test pit. At TS-06, thick black oily-like product coated soil from 17 feet to 20 feet bgs. TS-05 was the only treatability study test pit where impacted material was not observed.

For purposes of this EE/CA, it is assumed that the observation of oily-like free product indicates soil will exceed screening levels for petroleum products. Three composite soil samples were submitted to the laboratory for analysis. TS-COMP-1 comprised soil from TS-01 and TS-04; TS-COMP-2 comprised soil from TS-02 and TS-03; and TS-COMP-3 comprised soil from TS-05 and TS-06. The soil samples were collected from the vadose zone at approximately 12 feet bgs and thus represent the extent of impacted "deep" soil. The results (summarized in Table 3-1) indicated the following:

- The presence of diesel and heavy oil in all samples. The concentrations of diesel and heavy oil exceeded screening levels in TS-COMP-2 and TS-COMP-3
- Naphthalene exceeded screening levels in TS-COMP-1 and TS-COMP-2
- Arsenic, iron, and vanadium exceeded screening levels in all three samples
- Mercury screening level was exceeded in TS-COMP-3

4.1.2.2 EE/CA Investigation Test Pits

The test pits that were excavated as part of the EE/CA investigation (labeled TP-1 through TP-8 on Figure 3-1) targeted areas on-Site that had not been investigated before. Observations made during the excavation of these test pits indicated the quantity of impacted soil diminishes as you move west across the Site. In TP-1, gray to black stained soil was observed at 12 feet bgs to the bottom of the test pit. A

petroleum-like odor was observed in this test pit. The stained soil was also observed in TP-3 and TP-8, but at varying depths. Oily-like free product was observed on the water table in both of these test pits. No impacted material was observed in TP-4, TP-5, or TP-7. A localized zone of impacted soil was observed in TP-6. The odor that was observed in TP-6 at 8 feet bgs was more closely related to a fuel-like odor rather than the oil-like odor observed elsewhere onsite. Oily-like free product was observed on the water table at 17 feet bgs in this test pit.

The soil samples collected from the test pits indicate that there are some surface soil impacts in the upper four feet of the soil profile, as indicated by the black soil observed. Surface soils (in the upper 5 feet of the soil horizon), mid-depth soils (5-10 feet bgs) and deep soils (greater than 10 feet bgs) all appear to be impacted by diesel and heavy oil range petroleum products, PAHs, several volatile organic compounds, and some metals. In general, the test pits located closest to the suspected LNAPL plume had the highest concentrations and detections decreased with increasing distance from the plume. Specifically, the results (summarized on Table 3-1) indicated the following screening level exceedances:

Surface Soil (0-5 feet bgs)

- Heavy oil in excess of screening level in TP-1
- Benzo(a)pyrene in excess of screening level in TP-1, TP-2
- Arsenic, iron, manganese, mercury, and vanadium in excess of screening levels in all test pits
- Antimony and barium in excess of screening levels in TP-1
- Lead in excess of screening levels in TP-1, TP-2, TP-3, and TP-4
- Benzene in excess of screening level in TP-1 and TP-4
- Methylene chloride in excess of screening level in TP-2

Mid-Depth Soil (5-10 feet bgs)

- Diesel and heavy oil in excess of screening level in TP-1 and TP-6
- Benzo(a)anthracene, benzo(a)pyrene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene in excess of screening levels in TP-1. Benzo(a)pyrene was also detected above screening levels in TP-3
- Naphthalene in excess of screening levels in TP-6
- 1-Methylnaphthalene in excess of screening levels in TP-6
- Arsenic, iron, and vanadium in excess of screening levels in all test pits
- Manganese in excess of screening levels in all test pits except TP-1 and TP-6
- Mercury in excess of screening levels in all test pits except TP-5
- Lead in excess of screening levels in TP-4
- Trichloroethene in excess of screening levels in TP-2
- Benzene and xylenes in excess of screening levels in TP-6

Deep Soil (10+ feet bgs)

- Heavy oil in excess of screening level in TP-1
- Benzo(a)pyrene and dibenzo(a,h)anthracene in excess of screening levels in TP-1
- Naphthalene in excess of screening levels in TP-6
- Arsenic, iron, and vanadium in excess of screening levels in all test pits
- Manganese in excess of screening levels in TP-2, TP-3, and TP-4
- Mercury in excess of screening levels in TP-1, TP-4, TP-5, TP-6 and TP-7

Although no soil samples were collected from TP-8, potential free product was observed in the soil at the water table. It is unknown whether the free product observed in TP-8 was heavy oil or diesel, however it can be assumed that both were present because this was the case in treatability study test pits "smear zone" samples. The test pit results indicate that the extent of heavy oil exceeding screening levels includes TP-1 and extends as far as TP-8 locations. Additionally, there is a localized zone of heavy oil impact exceeding screening levels at mid-depth at GTP-6. All other soil in the western part of the Site is not impacted by diesel or heavy oil exceeding screening levels. There are PAHs associated with the zone of soil impacted by heavy oil in GTP-1 and GTP-6 that also exceed screening levels. Isolated detections of PAHs also occurred in GTP-2 and GTP-3. Volatile organic compounds associated with gasoline were also detected in GTP-6 above screening levels. These detections may be associated with a localized spill to soil and do not represent widespread impact as these constituents were not detected elsewhere onsite (with the exception of benzene in surface soil in TP-1 and TP-4). Metals were detected in soil exceeding screening levels at all depths and across the whole Site.

4.1.3 Borings

The soil borings were located in an area of the Site that had not been investigated previously, so the soil sample results from these locations help identify the northeastern extent (on the north side of the highway) of the soil impacts. Soil samples collected from the soil borings indicated that surface soils (within the upper four feet of the soil profile) are impacted by few contaminants. Specifically, surface soils are impacted by diesel and/or heavy oil range petroleum products and PAHs. The petroleum products were observed at each of the boring locations, whereas the PAHs were detected on the north side of Highway 50 (near the location of the former 500,000 gallon AST) and at BH-2 on the south side of Highway 50.

Soil samples collected from the soil borings at depths of 7.5 feet bgs from BH-4 and BH-5 on the north side of Highway 50 are also impacted by diesel and heavy oil range petroleum products and PAHs. The concentrations of these constituents detected at these depths were higher than in surface soils. For comparison purposes, the concentration of diesel detected in the 7.5 foot sample from BH-4 exceeded the MTCA Method A screening level. Because there are no petroleum product screening levels in Idaho, the Washington screening level was used as a surrogate. In the same soil sample, the concentration of benzo(a)pyrene (a carcinogenic PAH) exceeded the most conservative screening level for that

constituent. On the south side of Highway 50 in BH-1, BH-2, and BH-3 there were detections of diesel and heavy oil range petroleum products and PAHs, however the concentrations were less than the detections in borings on the north side of the highway. The highest concentrations of petroleum products and PAHs detected in all of the boring soil samples were in BH-4 at 7.5 feet bgs.

Soil samples collected from the soil borings at depths of 15 feet bgs from BH-4 and BH-5 on the north side of the highway had detections of diesel and heavy oil range petroleum products and PAHs; however at concentrations less than the detections in the 5-10 foot soil samples. In borings on the south side of the highway, there were detections of diesel and heavy oil range petroleum products and PAHs at concentrations greater than those detected at 7.5 feet bgs. BH-3 at 15 feet bgs had the highest detections of petroleum products and PAHs of the borings on the south side of the highway; however, these concentrations did not exceed screening levels. Free product was observed in soil at depths ranging from 13 to 20 feet bgs in BH-1, BH-2, and BH-5 and LNAPL was observed floating on groundwater in BH-3 and BH-5.

The detections above screening levels for soil samples collected from the borings are as follows:

Surface Soils (0-5 feet bgs)

- None

Mid-Depth Soil (5-10 feet bgs)

- Diesel range petroleum products in excess of screening levels in BH-4

Deep Soil (10+ feet bgs)

- None

4.1.4 Determination of Soil COPCs

As identified above, the following constituents have been identified in soil exceeding screening levels:

- Petroleum Hydrocarbons - Diesel and heavy oil range
- Metals - Antimony, arsenic, barium, iron, lead, manganese, mercury, and vanadium
- Volatile Organic Compounds – Benzene; ethylbenzene, methylene chloride; trichloroethene, and xylenes
- PAHs - Benzo(a)anthracene, benzo(a)pyrene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, naphthalene, 1-Methylnaphthalene, and 2-methylnaphthalene

The remainder of this section will discuss which of the above identified constituents will be considered COPCs for the Site.

4.1.4.1 Petroleum Hydrocarbons

Diesel and heavy oil range petroleum products were observed as free product in soil and were detected in soil samples at concentrations exceeding the MTCA Method A screening level. Both diesel and heavy oil

are recognized as COPCs for the Site soils at depths greater than 3 to 5 feet bgs within the estimated plume boundary, with the inclusion of impacted surface soil at TP-1.

4.1.4.2 Metals

Several metals were identified in soil samples across the site in excess of screening levels. Arsenic was detected at concentrations ranging from 3.6 mg/kg to 45 mg/kg during the EE/CA investigation and historical investigation. The concentrations are fairly consistent and most were less than 20 mg/kg with an average of 13.8 mg/kg. The average concentration is less than the EPA Removal Action Level, the Washington State's MTCA Method A unrestricted land use screening level, and the background concentration (22 mg/kg) for arsenic in soils in the Upper Coeur d'Alene Basin (EPA 2001). Due to the relatively consistent nature of the arsenic detections in soil, these detections are considered within the range of Site specific background concentrations and thus arsenic is not a soil COPC.

Antimony and barium were only detected at concentrations exceeding screening levels in one sample, which was collected at the surface of TP-1. All other detections were well below the most conservative screening level. The background concentration for antimony in the Upper Coeur d'Alene River Basin (EPA 2001) is 5.8 mg/kg, which is below the concentration detected in TP-1. There are no background levels established for barium. However, the screening levels that were used base the antimony and barium criteria on the protection of groundwater. Groundwater results have not indicated detections of antimony or barium above screening levels. The high detection of both of these metals is considered anomalous, and thus antimony and barium are no longer considered soil COPCs, especially considering groundwater has not been impacted by the isolated soil concentrations.

Iron was detected in all soil samples exceeding screening levels at concentrations ranging from 7,800 mg/kg to 20,000 mg/kg (up to 24,000 mg/kg in historical investigations); however, most samples had detected concentrations within the 13,000 mg/kg to 15,000 mg/kg range. The average iron concentration was 13,600 mg/kg. All of the sample results are less than the background soil concentration (65,000 mg/kg) for iron in the Upper Coeur d'Alene Basin (EPA 2001) and the background soil concentration (42,000 mg/kg) for iron in Washington (Washington State Department of Ecology [Ecology] 1994). Because of the consistent nature of the iron concentrations, it is surmised that these represent the range of Site specific iron background concentrations, and thus iron is not a soil COPC.

Lead was detected in four surface soil samples and one mid-depth sample exceeding screening levels during the EE/CA investigation and one sample during historical investigations. When the exceedances are compared to the Upper Coeur d'Alene Basin (EPA 2001) background lead soil concentration (171 mg/kg), only one surface soil sample exceeded this background value. This is the same sample that had the antimony and barium detections above screening levels that was collected from the surface of TP-1. The average lead concentration for Site soil samples collected during the EE/CA investigation was 44 mg/kg, which meets conservative screening levels. Soil screening levels for lead were based on the

protection of groundwater. Lead has only been detected in groundwater at the Site in one well, EMW-06 at concentrations exceeding screening levels during the 2007 investigation. Golder's re-sampling of this well during the EE/CA investigation did not detect lead above the laboratory PQL. Furthermore, Golder's groundwater results did not indicate lead above screening levels. Therefore groundwater has not been impacted by lead concentrations in soil. Because only one location had lead at concentrations exceeding regional background levels; the Site wide average lead concentration is 44 mg/kg; and groundwater has not been impacted by lead, it is assumed that this one exceedance of lead is anomalous. As such, lead is not considered a soil COPC.

Manganese was detected in EE/CA and historical investigation soil samples at concentrations ranging from 160 mg/kg to 560 mg/kg. The average manganese concentration was 317 mg/kg, which exceeds conservative screening levels but is far below the soil background concentration of manganese (3,597 mg/kg) for Upper Coeur d'Alene Basin (EPA 2001) and Washington State (1,100 mg/kg [Ecology 1994]). Given this information, it is reasoned that the manganese concentrations are within the normal range of Site specific background concentrations and this metal is not considered a soil COPC.

Mercury concentrations detected in the EE/CA investigation soil samples ranged from 0.0083 mg/kg to 0.11 mg/kg. During historic investigations, mercury ranged from 0.006 mg/kg to 0.03 mg/kg. The average mercury concentration detected during the EE/CA was 0.02 mg/kg, which exceeds conservative screening levels but is far below the soil background concentration of mercury (0.3 mg/kg) for the Upper Coeur d'Alene Basin (EPA 2001) and the more conservative Washington State Wide background level (0.07 mg/kg). Because the detections observed on-Site are within range for regional background concentrations, mercury is not considered a soil COPC.

Vanadium was detected in soils during the EE/CA investigation at concentrations ranging from 10 mg/kg to 37 mg/kg (an average of 19.5 mg/kg), with the majority of detections within 13 mg/kg to 18 mg/kg. There are no regional background levels for vanadium. Because of the consistency of detections and the lack of researched regional background levels, it is reasoned that the vanadium concentrations are within the normal range of Site specific background concentrations and this metal is not considered a soil COPC.

4.1.4.3 Volatile Organic Compounds

Several volatile organic compounds were detected occasionally in soil samples collected during the EE/CA investigation that exceeded screening levels. These constituents included benzene, methylene chloride, trichloroethene, and total xylenes. The following is a discussion of which of these (if any) are considered COPCs for soil.

Benzene was detected in three soil samples during the EE/CA investigation at concentrations up to 0.045 mg/kg, which exceed the most conservative screening level (IDTL- 0.018 mg/kg, which is based on the protection of groundwater), but are well below other screening levels (EPA Removal Action Level -

113 mg/kg and EPA Regional Screening Level- 1.1 mg/kg). During historical investigations, benzene was not detected above the laboratory reporting limit (0.003-0.005 mg/kg). The IDTL screening level for benzene was set for the protection of groundwater. Although the EE/CA activities did not investigate volatile organic compounds in groundwater, historical groundwater results indicated that benzene was not detected above the laboratory reporting limit of 1 µg/L, below federal drinking water standards. Because benzene was detected infrequently, at low concentrations, and has not been detected in groundwater, it is not a COPC for soil.

Methylene chloride was detected in one EE/CA investigation soil sample (TP-2 at the surface) at concentrations of 1.6 mg/kg. Methylene chloride is a compound used in analytical-laboratories and is a common contaminant during sample analysis. Furthermore, methylene chloride was detected in the laboratory method blank during the analysis of the EE/CA soil samples. As per proper validation rules, the laboratory reported that all samples with concentrations of methylene chloride less than 10 times the blank concentration were flagged as non-detects, but the presence of this compound in the blank makes all sample results suspect. All detections were flagged as non-detects except for that from TP-2 because the concentration was greater than 10 times the blank concentration. Nevertheless, it is suspected that this single detection of methylene chloride was anomalous, and is not considered a COPC.

Trichloroethene was detected in one mid-depth sample collected during the EE/CA investigation at a concentration exceeding the most conservative screening levels (IDTL - 0.0029 mg/kg) but did not exceed other noted screening levels (EPA Removal Action Level- 283 mg/kg or EPA Regional Screening Level- 2,800 mg/kg). There were no detections of trichloroethene during historical soil sampling. The IDTL screening level for trichloroethene was set for the protection of direct contact by a child. However, because the exceedance of screening levels was by one soil sample collected from mid-depth, the screening level based on child exposure is not applicable; rather, protection of groundwater screening levels are more appropriate. Although the EE/CA activities did not investigate volatile organic compounds in groundwater, historical groundwater results indicated that trichloroethene was not detected above the laboratory reporting limit of 1 µg/L, which is below conservative groundwater screening levels. Because trichloroethene was only detected in one mid-depth soil sample and because this constituent has not been detected in groundwater, trichloroethene is not a soil COPC.

Total xylenes (m-Xylene, p-xylene, and o-xylene) were detected in one, mid-depth EE/CA soil sample at a concentration exceeding conservative IDTL screening levels, but was not detected exceeding other noted screening levels (EPA Removal Action Level- 1,840 mg/kg or EPA Regional Screening Level- 600 mg/kg). The IDTL screening level for total xylenes was set for the protection of direct contact of a child. However, because the exceedance of screening levels was by a soil sample collected from mid-depth, the screening level based on child exposure is not applicable; rather, protection of groundwater screening levels are more appropriate. Although the EE/CA activities did not investigate volatile organic compounds in groundwater, historical groundwater results indicated that m,p-xylenes were not detected

above the laboratory reporting limit of 2 µg/L, which is below conservative screening levels. Because total xylenes were only detected in one, mid-depth soil sample above conservative screening levels and because it has not been detected in groundwater, total xylene is not a soil COPC.

4.1.4.4 PAH

Eight PAHs were detected in EE/CA and historical soil samples, including: benzo(a)anthracene, benzo(a)pyrene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, naphthalene, 1-Methylnaphthalene, and 2-Methylnaphthalene (identified only in historical samples above screening levels). The surface soils had detections of benzo(a)anthracene, benzo(a)pyrene, benzo(a)fluoranthene, and dibenzo(a,h)anthracene. Sub-surface soil samples detected all eight of the PAHs listed above. The prevalence of these constituents at various locations above screening levels and depths across the Site make them COPCs. From here forward, these constituents will be referred to as PAHs when discussing the nature and extent of COPCs.

4.2 Extent of Sediment Impact

4.2.1 Historical Sediment Sample Results

E & E did not collect sediment samples during their investigation in 2007. However, E & E observed product seeping from the river bank along the property line.

4.2.2 EE/CA Investigation Sediment Sample Results

The analytical data and field observations indicated the presence of free product in sediment collected from river stations along the property line. Free product and a petroleum sheen were observed in the shoreline and off-shore sediment samples collected from RS-2, RS-3, RS-4, RS-5, and RS-6. Free product was observed in sediment at locations where no free product or sheen was visible on the surface water prior to sample excavation. The highest concentrations of diesel and heavy oil were detected in the RS-4 shoreline sample. During additional investigation activities, free product was observed in sediment up to 5.5 feet from the shoreline at RS-3, and four feet from the shoreline at RS-4. Other detections in sediment samples included PCBs (Aroclor 1260 in the off-shore sample from RS-1), PAHs, several metals, and SVOCs. These detections were mainly in samples collected from RS-1, RS-3, RS-4, and RS-5, the areas where impact by free product was readily visible.

The following is a summary of the constituents that were detected in sediment samples exceeding screening levels:

Shoreline Samples

- The presence of visible diesel and heavy oil in samples collected from RS-2, RS-3, RS-4, RS-5, and RS-6.
- One or more of the following PAHs were detected at RS-1, RS-2, RS-3, and RS-4 at concentrations exceeding screening levels: acenaphthene, anthracene,

benzo(a)anthracene, benzo(a)pyrene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorine, indeno(1,2,3-cd)pyrene, phenanthrene, pyrene, and 2-methylnaphthalene.

- Arsenic was detected in all samples, except RS-1, at concentrations above screening levels.
- Antimony was detected in samples from RS-3 and RS-4 at concentrations exceeding screening levels.
- Copper was detected in all samples at concentrations above screening levels.
- Lead was detected at RS-4 at a concentration exceeding screening levels.

Off-shore Samples

- The presence of visible diesel and heavy oil in samples collected from RS-2, RS-3, RS-4, RS-5, and RS-6.
- One or more of the following PAHs were detected at RS-1, RS-2, RS-3, RS-4, and RS-5 at concentrations exceeding screening levels: acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, fluorine, indeno(1,2,3-cd)pyrene, phenanthrene, pyrene, and 2-methylnaphthalene.
- Arsenic was detected in all samples, except RS-8, at concentrations above screening levels.
- Antimony was detected in samples from RS-1, RS-2, RS-5, and RS-7 at concentrations exceeding screening levels.
- Copper was detected in all samples at concentrations above screening levels.
- Lead was detected at RS-1 and RS-7 at a concentration exceeding screening levels.

4.2.3 Determination of Sediment COPCs

The remainder of this section will discuss which of the above identified constituents will be considered COPCs for the Site. Once the COPCs for sediment have been defined, they will be evaluated based on human and ecological risk in order to identify the sediment COCs for this Site (in Section 5).

4.2.3.1 Petroleum Hydrocarbons

Diesel and heavy oil range petroleum products were observed as free product in sediment and were detected in sediment samples. Both diesel and heavy oil are recognized as COPCs for the Site sediment along the shoreline and up to five feet off-shore at RS-2, RS-3, RS-4, RS-5, and RS-6.

4.2.3.2 Metals

Several metals were identified in sediment samples across the site in excess of screening levels. Arsenic was detected at concentrations exceeding screening levels, ranging from 6.2 mg/kg to 28 mg/kg. The average arsenic concentration was 9.9 mg/kg. The average background sediment concentration in the Upper Coeur d'Alene River Basin (EPA 2001) is 13.6 mg/kg. Because the average Site sediment sample arsenic concentration is below regional background levels, arsenic is not considered a sediment COPC.

Antimony was detected at concentrations exceeding the conservative EPA Freshwater Sediment Screening Benchmark level (2 mg/kg) at several locations. No other screening levels for antimony were available for comparison. The detections of antimony exceeding screening levels ranged in concentration from 2.3 mg/kg to 210 mg/kg. Most of the detections were below 8 mg/kg, except for a detection of 24 mg/kg at RS-4 and 210 mg/kg at RS-7. Antimony background sediment concentrations in the Upper Coeur d'Alene River Basin (EPA 2001) is 3.3 mg/kg. The 210 mg/kg concentration of antimony was detected in a sediment sample from RS-7, located down-stream of the impacted portion of the Site. The anomalous detections of antimony above screening levels may be related to deleterious material observed in the river sediment, in particular lead fishing weights and anchors, because antimony is associated with these types of lead materials. Therefore, antimony is considered anomalous in this sample and not a COPC for Site sediment.

Copper was detected above screening levels in all sediment samples collected from the Site, ranging in concentration from 17 mg/kg to 58 mg/kg. The average copper detection was 26 mg/kg. The background level for copper in sediments in the Upper Coeur d'Alene River Basin (EPA 2001) is 32.3 mg/kg. Because of the relatively consistent detections of copper in sediment and the fact that the average detection was below background levels, this metal is not a COPC for Site sediment.

Lead was detected above screening levels in three samples collected. The detections of lead exceeding screening levels were 45 mg/kg, 48 mg/kg, and 600 mg/kg. The background concentration for lead in the Upper Coeur d'Alene River Basin (EPA 2001) is 51.5 mg/kg. The anomalous detection of lead at 600 mg/kg may be related to deleterious material, including fishing lead weights, observed in the river sediment. This concentration of lead was detected in a sediment sample from RS-7, located down-stream of the impacted portion of the Site and is the same sample that contained antimony at 210 mg/kg. Antimony is often associated or alloyed with lead. Because only one sample exceeded regional background levels and that sample was located away from the impacted portion of the Site, lead is not considered a COPC for sediment.

4.2.3.3 PAHS

Fourteen PAHs (carcinogenic and non-carcinogenic) were detected above screening levels in the EE/CA sediment samples, including: acenaphthene; anthracene; benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; benzo(k)fluoranthene; chrysene; Dibenzo(a,h)anthracene; fluorene; fluoranthene; Indeno(1,2,3-cd)pyrene; 2-methylnaphthalene; phenanthrene; and pyrene. It is suspected that the PAHs are related to the presence of petroleum products in the sediment. The prevalence of these constituents at various river stations across the Site make them COPCs. From here forward, these constituents will be referred to as PAHs when discussing the nature and extent of COPCs.

4.3 Extent of Groundwater Impact

4.3.1 Historical Groundwater Sample Results

Historical groundwater sampling conducted by Hart Crowser identified total petroleum hydrocarbons in samples collected from HC-1R and HC-5. Groundwater sampling conducted by E & E in 2007 indicated concentrations of PAHs and PCBs above screening levels in EMW-02, EMW-04, and EMW-06. Several metals were detected at concentrations above screening levels in all wells sampled by E & E. Diesel and heavy oil range petroleum products were detected in all groundwater samples, but exceeded Washington State MTCA Method A screening levels (500 µg/L) only in EMW-02, EMW-03, EMW-04, EMW-05, EMW-06, and HC-1R. Free product was observed during monitoring well installation at EMW-02, EMW-04, EMW-05, and EMW-06. Free product was observed during groundwater level assessments in HC-4, MW-11, EW-3, and EW-4.

The condition of the groundwater samples collected by E & E is suspected to be a potential cause of some of the PAH and high metals detections. It is uncertain whether a drop tube or other sample collection device was used to collect a groundwater sample below floating LNAPL. The use of such devices reduces the risk of free product carry down when the instruments are lowered into the water column. Without the use of a drop tube or other collection device the concentration of PAHs may be biased high due to LNAPL carry down, and the results of which may not be representative of dissolved constituents in the water phase. Additionally, it is understood that the turbidity of all of the samples collected by E & E were above 5 NTU, and there is no indication that filtered samples were collected. Turbidity greater than 5 NTU will greatly influence the amount of total metals detected in a sample, causing the detected concentration to be biased high. Again, the metals data collected by E & E is suspected to not be representative of the dissolved metals in the water phase. This is exemplified by the fact that the dissolved metals samples collected by Golder had detections of most metals at concentrations less than the E & E samples collected from the same wells.

4.3.2 EE/CA Investigation Groundwater Sample Results

Free product was observed in HC-4, MW-11, GA-01, EMW-04, and EMW-06 during groundwater level assessments. Additionally, a sheen or odor was observed on purge water from GA-1, EMW-04, EMW-05, EMW-06, and HC-1R. Groundwater sampling results indicated detections of the following constituents above screening levels:

- Diesel and heavy oil range petroleum products above MTCA Method A screening levels (500 µg/L) in MW-5, HC-1R, EW-3, EMW-05, and EMW-06.
- Naphthalene and 1-methylnaphthalene were detected at concentrations exceeding screening levels in MW-5, EMW-05, and EMW-06.
- Total arsenic was detected above screening levels in GA-3, MW-5, EW-3, EMW-04, GA-1, EMW-05, and EMW-06. Dissolved arsenic was above screening levels in EMW-04, GA-1, EMW-05, and EMW-06. Dissolved samples were not analyzed from GA-3 and MW-5.

- Total aluminum exceeding screening levels in the sample from MW-5.
- Total iron was detected above screening levels in DW-01, MW-5, EW-3, EW-4, EMW-04, GA-1, EMW-05, and EMW-06. Dissolved iron was above screening levels in DW-01, EW-3, EMW-04, EMW-05, EMW-06, and GA-1. Dissolved samples were not analyzed from MW-5 and EW-4.
- Total manganese was detected at concentrations exceeding screening levels in all wells, except for HC-1R. Dissolved iron was above screening levels in GA-4, GA-3, EW-3, EMW-04, EMW-05, and EMW-06. Dissolved samples were not analyzed from GA-2, DW-01, MW-5, EW-4, and GA-1.

4.3.3 Determination of Groundwater COPCs

The remainder of this section will discuss which of the above identified constituents will be considered COPCs for groundwater at the Site. Once the COPCs for groundwater have been defined, they will be evaluated based on human risk in order to identify the groundwater COCs for this Site (in Section 5).

4.3.3.1 Petroleum Hydrocarbons

Diesel and heavy oil range petroleum products were observed as free product in monitoring wells and were detected in the water phase in groundwater samples. Both diesel and heavy oil are recognized as COPCs for the Site groundwater.

4.3.3.2 Metals

Several metals were identified in groundwater samples across the Site in excess of screening levels. Total arsenic was detected above conservative screening levels (EPA Regional Screening Levels - 0.045 µg/L) in seven monitoring wells. Other identified screening levels (including the federal MCL) for arsenic are 10 µg/L. Only four detections exceed this moderate screening level. Concentrations above screening levels ranged from 0.91 µg/L to 63 µg/L. Dissolved arsenic concentrations (when analyzed) were relatively similar to total arsenic concentrations, except for EW-3. A dissolved sample was not collected from MW-5 due to the limited volume of water (1.9 total feet of water) in that well and the slow recharge conditions. As a result, the groundwater sample collected from MW-5 was turbid, which likely caused the elevated arsenic concentration. The arsenic concentration in MW-5 is not representative of the groundwater conditions due to the compromised nature of this sample. Elevated arsenic in groundwater is believed to be the result of the geochemical change of groundwater caused by the presence of petroleum hydrocarbons, which enhances the dissolution of naturally occurring arsenic in soil. There is no evidence of an anthropogenic source of arsenic in the soil. Because the State groundwater standard of 50 µg/L was exceeded in several of the groundwater samples, and because Idaho will soon revise its surface water criteria to 10 µg/L , arsenic is a COPC for groundwater at the Site.

Total aluminum was only detected in one EE/CA groundwater sample (MW-5) above the conservative screening levels (State Secondary MCL - 200 µg/L). The detection was below other identified screening levels (EPA Removal Action Levels- 86,400 µg/L and EPA Regional Screening Levels- 37,000 µg/L). This detection was in the turbid sample collected from MW-5. Aluminum was detected in historical groundwater samples collected from EMW-02, EMW-05, and EMW-06; however the condition of these

samples is unknown. Golder's re-sampling of EMW-05 and EMW-06 during the EE/CA investigation indicated aluminum below screening levels. Because aluminum was only detected above conservative screening levels in one groundwater sample that was of poor quality, it is suspected that this detection is not representative of the true groundwater conditions, and therefore aluminum is not a groundwater COPC.

Total iron was detected in eight of the groundwater samples at concentrations exceeding the most conservative screening level (State Secondary MCL – 300 µg/L). All of these concentrations are below the EPA Removal Action Level (60,500 µg/L) and if dissolved samples results are used, all samples are below the EPA Regional Screening Level (26,000 µg/L). The iron concentration in DW-01 may be related to the rusting of the well screen and/or the pump. Most of the water purged from DW-01 had suspended rust colored particles. The presence of iron in MW-5 may be related to the turbidity in that sample. A filtered sample was not collected from MW-5 due to the limited productivity of that well. All of the other detections of iron above screening levels are in wells where petroleum hydrocarbons are present now or have been present in the past. Detected concentrations of iron were low in wells that are not impacted with petroleum hydrocarbons. The increased presence of dissolved iron may be an indication of an anaerobic groundwater condition caused by the presence of petroleum hydrocarbons. Because the state groundwater standard for iron was exceeded, iron is considered a groundwater COPC.

Total manganese was detected in all wells, except HC-1R, at concentrations exceeding the most conservative screening level (State Secondary MCL - 50 µg/L). If less restrictive screening levels are used (EPA Removal Action Levels – 2,070 µg/L or EPA Regional Screening Levels- 880 µg/L), then only those wells with petroleum hydrocarbons are present now or have been present in the past exceed screening levels. Only two samples (EW-3 and EMW-05) detected manganese at concentrations exceeding the highest screening level of 2,070 µg/L. All of the samples collected by E & E in 2007 had concentrations of manganese exceeding the highest screening level, except for the samples collected from EMW-01, MW-5, and DW-01. The concentrations of manganese in impacted wells were higher in 2007 than the concentrations detected during the EE/CA, which may be an indication of the turbidity and quality of samples collected by E & E. The lowest detections of manganese have been in wells that are not impacted by petroleum products. The increased presence of dissolved manganese may be an indication of anaerobic groundwater conditions caused by the presence of petroleum hydrocarbons. Because the state groundwater standard for manganese was exceeded, manganese is considered a groundwater COPC.

Golder will be conducting a groundwater sampling event in the spring of 2010 and will be able to confirm the dissolved metals detections (in the water phase) in all of the wells on-Site.

4.3.3.3 PAHs

Two PAHs (naphthalene and 1-methylnaphthalene) were detected in three of the EE/CA groundwater samples above conservative screening levels. These were detected in MW-5, EMW-05, and EMW-06. Six additional PAHs (2-methylnaphthalene, benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[g,h,i]perylene, and chrysene) were detected in historical groundwater samples. These were detected in EMW-02, EMW-04, and EMW-06 during the 2007 investigation. The EE/CA investigation re-sampled EMW-06 and did not detect the historically detected PAHs at concentrations exceeding screening levels; however, these constituents are considered COPCs for groundwater because they were detected in EMW-02 at concentrations exceeding screening levels, which was not re-sampled by Golder. The prevalence of naphthalene and 1-methylnaphthalene at various monitoring wells across the Site also make them groundwater COPCs. Golder will be conducting a groundwater sampling event in the spring of 2010 and will be able to confirm the PAH detections in all of the wells on-Site.

4.3.3.4 SVOCs

Two SVOCs were historically detected in groundwater samples: bis[2-ethylhexyl]phthalate and n-nitrosodiphenylamine. The EE/CA investigation did not analyze groundwater samples for SVOCs. Furthermore, bis[2-ethylhexyl]phthalate was detected in the laboratory blank during analysis in 2007. As per proper validation rules, the laboratory reported that all samples with concentrations less than 10 times the blank concentration were flagged as non-detects, but the presence of this compound in the blank makes all sample results suspect. N-nitrosodiphenylamine was detected in only one sample (EMW-06) at a concentration at the screening level. This appears to be an anomalous detection. SVOCs, other than PAHs, are not considered a COPC for groundwater at the Site.

4.3.3.5 PCBs

PCBs were not detected in groundwater samples collected during the EE/CA investigation. PCB Aroclor 1260 was detected in the groundwater sample collected from EMW-06 during the 2007 investigation at the same concentration as the conservative IDTL screening level. The concentration detected in EMW-06 was below all other notable screening levels (Federal Primary MCL- 0.5 µg/L, EPA Removal Action Level- 0.5 µg/L, and EPA Regional Screening Levels for tap water- 0.034 µg/L). This is the same Aroclor detected in free product at the Site. Free product was observed on the water table at EMW-06. It is suspected that the groundwater sample collected during the 2007 investigation was impacted by free product carry-down during tubing insertion in the well, in particular because a drop tube or other sampling technique to avoid carry-down was not implemented. This is the most likely scenario because PCBs have not been detected in any other groundwater samples collected from the Site. Because of the potential for this sample being impacted by free product and the relatively low detected concentration, PCBs are not a groundwater COPC for the Site.

4.3.4 Potential Groundwater to Surface Water Impacts

Due to the Site's proximity to the river and the known groundwater flow direction, groundwater detections were compared to the Idaho Water Quality Standards (IDAPA 58.01.02) in order to understand the potential for groundwater contaminants to impact surface water resources. Groundwater sampling results indicated detections of the following constituents above Idaho Water Quality Standards:

- Benzo(a)anthracene was detected at concentrations exceeding standards in MW-5 and EMW-06.
- Chrysene was detected at concentrations exceeding standards in GA-1, MW-5, EMW-04, and EMW-06.
- Arsenic was detected above the current standard (50 µg/L) in EMW-05. Idaho will soon revise the arsenic standard to 10 µg/L, which was exceeded in MW-5, EW-3, EMW-04, EMW-05, and EMW-06.
- Copper and lead were detected at concentrations above standards in MW-5.
- Thallium was detected at concentrations above standards in EW-3, EMW-04, EMW-05, and EMW-06.
- Zinc was detected at concentrations above standards in EW-3 and EW-4.

4.3.4.1 Determination of Groundwater to Surface Water COPCs

The remainder of this section will discuss which of the above identified constituents will be considered COPCs for the groundwater to surface water pathway. Once the COPCs for groundwater to surface water have been defined, they will be further evaluated based on human and ecological risk in order to identify the groundwater to surface water COCs for this Site (in Section 5).

The quality of the groundwater sample collected from MW-5 was poor due to insufficient water in the well and the sample was highly turbid, as identified earlier in this report. As such, the groundwater results from this monitoring well do not represent the general condition of the aquifer, because the high turbidity contains "smear zone" soil particles that would result in additional concentrations of COPCs than contained in just the water phase. Therefore, the analytical results for groundwater sample from MW-5 should not be used to determine groundwater to surface water COCs. This, therefore, eliminates copper and lead from the list of COPCs for the groundwater to surface water pathway.

Zinc was detected at concentrations exceeding water quality standards in EW-3 and EW-4. The concentrations in EW-3 and EW-4 were several orders of magnitude greater than any of the other zinc detections. It appears that both of these wells were constructed using potentially galvanized steel pipe, which would be the likely source of the zinc. None of the other wells on-site that were sampled are constructed using this material and thus did not have zinc concentrations above the standard. As such, zinc is eliminated from the list of COPCs for the groundwater to surface water pathway.

Benzo(a)anthracene, chrysene, arsenic, and thallium were detected at concentrations above water quality standards in several wells during the EE/CA investigation and the 2007 E & E investigation. All four of these compounds are considered COPCs and are further evaluated in Section 5.

4.4 Extent of Surface Water Impact

4.4.1 Historical Surface Water Sample Results

Observations made during E & E's 2007 investigation indicated free product seeping from the river banks into the St. Joe River. Free product and a petroleum sheen were observed on the surface water. Two surface water samples were collected from within the free product seep area. Surface water sample results indicated detections of PAHs and barium at concentrations above screening levels. PAHs were only detected in one sample, collected near Golder's RS-4 sampling location. Diesel and heavy oil range petroleum products were also detected in all surface water samples.

4.4.2 EE/CA Investigation Surface Water Sample Results

Surface water samples were collected during the EE/CA investigation from eight river stations. The results indicated only benzo(a)anthracene and chrysene detected in the sample collected from RS-4 at concentrations exceeding screening levels. This river station was the location of the largest LNAPL plume.

4.4.3 Determination of Surface Water COPCs

The remainder of this section will discuss which of the above identified constituents will be considered COPCs for surface water at the Site. Once the COPCs for surface water have been defined, they will be evaluated based on human and ecological risk in order to identify the surface water COCs for this Site (in Section 5).

4.4.3.1 Petroleum Hydrocarbons

Diesel and heavy oil range petroleum products were observed as free product floating on the surface water. Dissolved diesel and heavy oil range petroleum products were not detected in surface water samples collected during the EE/CA investigation, but were detected in the water phase in surface water in 2007. Both diesel and heavy oil as LNAPL are recognized as COPCs for the Site surface water.

4.4.3.2 PAHs

Two PAHs (benzo[a]anthracene and chrysene) were detected in only one of the EE/CA surface water samples (RS-4) above conservative screening levels. Two additional PAHs (benzo[a]pyrene and benzo[b]fluoranthene) were detected in a historical surface water sample (E & E sample location SW-03). It is suspected that these constituents are present in surface water because of the LNAPL present on the surface water at the sampling locations. PAHs may have been detected in the surface water samples due to the carry-down effect of free product on sampling equipment. Because the EE/CA investigation collected surface water samples in similar locations as the samples collected in 2007, the assumption is made that the benzo[a]pyrene and benzo[b]fluoranthene results could not be replicated and thus, those constituents are not of concern at the Site. The prevalence of benzo[a]anthracene and chrysene in surface water at the active LNAPL plume locations make them surface water COPCs. From here

forward, these constituents will be referred to specifically when discussing the nature and extent of COPCs for surface water.

4.4.3.3 Metals

Barium was the only metal detected in surface water samples during the 2007 investigation, at concentrations exceeding the Federal Ambient Water Quality Criteria of 4 µg/L. The concentrations detected during the 2007 investigation were relatively consistent, ranging from 4.71 µg/L to 5.11 µg/L. The EE/CA investigation detected barium at concentrations ranging from 7.2 µg/L to 13 µg/L (although most were between 7.2 µg/L and 8.1 µg/L). The sample collected from RS-1, the background or up-gradient sample, had a concentration of 7.9 µg/L. There were no screening levels identified for barium in surface water in the QAPP, likely because of limited research on the health effects of barium. However, EPA issued a National Recommended Water Quality Criteria guidance document in 2002 (as cited in the U.S. Department of the Interior Bureau of Land Management Risk Management Criteria for Metals at BLM Mining Sites, 2004) that listed a screening level for barium for the protection of human health through consumption of water and organisms as 1,000 µg/L. Because of the relatively consistent detections of barium, it is assumed that these detections represent the Site specific background concentrations. Under Idaho Water Quality standards, background concentrations are the water quality criteria. Additionally, all of the detections were far below the EPA National Recommended Water Quality Criteria. Therefore, barium is not considered a COPC for Site surface water.

4.5 Extent of LNAPL Impact

The extent of LNAPL observed in soil, groundwater, and surface water during the EE/CA investigation is depicted on Figure 4-3. Figures 4-4 and 4-5 depict the LNAPL plume boundaries delineated by Hart Crowser (2000), Farallon Consultants (2006), and E & E (2007). Golder's plume delineation on Figure 4-3 extends further to the west than previous delineations have shown because of the expanded data collection on the western side of the Site during the EE/CA investigation. The 2007 E & E report concludes that the area of the free product plume has grown to the west and southwest since the 2000 Hart Crowser delineation. However, Golder disputes this conclusion because of the data gaps that remained for the western side of the Site after the 2000, 2006, and 2007 investigations. For example, Farallon estimated the western plume boundary (depicted in Figure 4-4) terminated at TP-8, TP-9, and TP-10 where oil was observed, but there were no other data collection points to the west of these test pits (until HC-1 and HC-1R locations) that provided any indication that the soil and/or groundwater was free of product. The apparent change in LNAPL extent could be a result of expanded sampling locations where data gaps previously existed. For example, no LNAPL has been observed at HC-1 or HC-1R in the past or present.

A distinction is made between LNAPL floating on the groundwater and LNAPL present at the near shore because the characteristics of these LNAPL's are different (see below).

4.5.1 Groundwater LNAPL

LNAPL of a measurable quantity found in monitoring wells was sampled and submitted for laboratory analysis. The constituents identified in the LNAPL were diesel and heavy oil range petroleum products, PCBs (Aroclor 1260), PAHs and metals. PCBs were only identified in the product collected from MW-11 (during the EE/CA investigation) and in HC-4 (during the 2007 investigation). PCBs were not detected in any of the wells with LNAPL that are closer to the river. There are no standards to which LNAPL results could be compared. LNAPL and all of the constituents found within the product floating on the groundwater are considered COPCs.

4.5.2 Near Shore LNAPL

LNAPL observed in the near shore area either floating on the surface water or emerging from sediment was also sampled and analyzed by the laboratory. Diesel and heavy oil range petroleum products, few PAHs, and metals were detected in the LNAPL. PCBs were not detected in the LNAPL found along the near shore. The absence of PCBs from the LNAPL along the near shore indicates that PCBs are not being discharged to the river by on-site sources. LNAPL and all of the constituents found within it at the near shore are considered COPCs.

4.6 Summary of Site Impacts & COPCs

4.6.1 Summary of Impacted Soil Extent

Golder's soil investigation has identified an expanded area of impacted soil than has previously been identified. Some surface soil impacts were observed on-Site, but they were predominantly localized. Free product and the presence of COPCs have been identified on the north side of Highway 50 (former location of 500,000 gallon AST) at 7.5 feet bgs and the impact spreads to the south-southwest. The smear zone on the north side of the highway is at approximately 7.5-10 feet bgs. The location of the zone of impacted soil increases with depth below ground surface, with increasing distance to the south-southwest. The trajectory of the zone of impacted soil is consistent with the general direction of groundwater flow (discussed later in this Section). See Figure 4-3 for approximate plume delineation. The smear zone on the Site ranges from 12-17 feet bgs, depending upon the location and distance from the source. The soil COPCs that were defined above are:

- Diesel and heavy oil range petroleum hydrocarbons
- PAHs

4.6.2 Summary of Impacted River Sediment Extent

The EE/CA investigation results have indicated that background river sediment is impacted by contaminants. Most notably, samples from RS-1 had concentrations of petroleum products, PCBs, and PAHs. The highest concentrations were detected four feet from the shoreline at RS-1. This is a clear indication that river sediments are not pristine on the north shore of this river.

Golder's sediment investigation has identified an expanded area of impacted sediment than has previously been identified because previous plume maps were based on the observation of free product seeping from the river banks. The zone of impacted surface sediment appears roughly triangular in shape, extending along the shoreline between RS-2 and RS-6 at its widest points, and extends approximately five feet into the river at approximately RS-3. It is unknown whether the product in the sediment is a remnant from historic releases, or has occurred since the installation of the impermeable vertical wall by Hart Crowser in 2000. See Figure 4-3 for the approximate plume delineation. The sediment COPCs that were defined above are:

- Diesel and heavy oil range petroleum hydrocarbons
- PAHs

4.6.3 Summary of Impacted Groundwater Extent

The horizontal extent of the impacted groundwater (water phase components- total and dissolved) is similar to the delineation in 2007; however, the concentrations detected during the EE/CA investigation are not as elevated as in 2007. Free product continues to be identified in EMW-06, HC-4, MW-11 and was also observed in GA-1. The highest concentrations of COPCs (total and dissolved) in the water phase in groundwater were detected in the area southwest of the former 500,000 gallon AST (in the vicinity of EW-3 and EMW-06). The horizontal extent of impact continues to the west-southwest across the Site and terminates near to the west of HC-1R. This direction of movement is consistent with the general flow of groundwater. The groundwater COPCs that were defined above are:

- Diesel and heavy oil range petroleum hydrocarbons
- PAHs

4.6.3.1 Arsenic, iron, and manganese Impact from Groundwater to Surface Water

Because groundwater discharges from the Site into the St. Joe River, there is the potential for groundwater contaminants to impact the river. The potential groundwater to surface water pathway COPCs that were defined above are:

- Benzo(a)anthracene
- Chrysene
- Arsenic
- Thallium

4.6.4 Summary of Impacted Surface Water Extent

Surface water at this Site has the potential to be impacted in two ways: 1) from groundwater discharges and 2) from LNAPL seepage. After analyzing both the groundwater and surface water sample results, it appears that no material risk of impact to surface water from groundwater exists, other than the discharge of LNAPL. The only manner that the water phase of the groundwater system is an potential risk is if humans utilize surface water for potable water supply at the Site. This is exemplified by the detections in

surface water being negligible. If groundwater had a major influence discharging to surface water, then the constituents detected in groundwater would be detectable in surface water. The detections that were observed in surface water appear to be more closely related to the presence of LNAPL. That being said, the surface water COPCs are from LNAPL discharges and include:

- Diesel and heavy oil range petroleum products
- Benzo[a]anthracene and chrysene

4.6.5 Site COPCs

Table 4-1 summarizes the COPCs that have been determined for each of the impacted media on-Site and provides the maximum concentration detected (citing both the 2007 and 2009 data). These COPCs will be further screened in Section 5 to determine the final COCs for the Site.

4.7 Physical Nature of the Site

4.7.1 Groundwater

The interaction between groundwater and river is dynamic with season, antecedent rainfall and snow melt, and river levels. The hydrogeologic study focused on the groundwater directly beneath the Site with the intent to monitor fluctuations in groundwater elevation relative to fluctuations in the river, and the seasonal influence on groundwater flow direction. Static groundwater levels were measured in wells across the Site during two events: September 1, 2009 and November 19, 2009. Figure 4-1 depicts the observed groundwater levels on-site on September 1, 2009 and the estimated direction of flow. Figure 4-2 depicts the groundwater levels for November 19, 2009 and the estimated direction of flow at that time. The groundwater level surveys during the late summer and fall of 2009 indicated that at that time of the year, groundwater flows in the southwest direction and ultimately discharges to the river. Data collected by E & E in April 2007 was used to analyze the direction of groundwater flow during the seasonal high water levels. A review of groundwater level data collected by E&E personnel on April 21, 2007 suggests that groundwater discharging into the river, may shift seasonally such that surface water may flow from the St. Joe River onto the eastern portion of the Site (Bentcik property) becoming groundwater. This is demonstrated by the April 2007 groundwater levels measured in MW-5 (89.87 ft), which were higher than the groundwater level measured in EMW-02 (89.3 ft) and lower than the leave measured in EMW-01 (89.93 ft). Based on a triangulation of equipotentials among those three measurements, it appears that river water is moving into Site groundwater in this portion of the Site. See Figure 3-3 in the E & E report (2007) in Appendix G. Seasonal fluctuations in groundwater flow direction between a floodplain and an adjacent river is a common occurrence. This can be particularly evident in river systems with significant seasonal flow fluctuations. This seasonal fluctuation will be monitored by Golder in April 2010 during the second groundwater sampling event.

The average hydraulic gradient for the Site in September and November 2009 was calculated using the water level measurements from that time period. The average hydraulic gradient ranges from

0.004 foot/foot to 0.0034 foot/foot, respectively. The average hydraulic conductivity within the LNAPL plume area (calculated using data from the slug tests) is 1.06 feet/day. The accuracy of the calculated hydraulic conductivity from slug tests may be an order of magnitude from the actual aquifer condition. The average linear groundwater velocity within the LNAPL plume in September 2009 was 0.017 feet/day and in November 2009 was 0.014 feet/day.

Although the EE/CA investigation did not involve collection of groundwater samples up-gradient of the Site, results collected by E & E in 2007 from EMW-01 (the most up-gradient well in the vicinity of the Site) indicated that groundwater up-gradient of the Site does not have constituents of concern in excess of screening levels. However, some PAHs and diesel were detected. This possibly represents the condition of the groundwater that is entering the Site from up-gradient off-Site locations.

Groundwater has been impacted by the free product in the soil smear zone. The free product is not only contributing LNAPL to the aquifer, but also dissolved fractions of PAHs and petroleum hydrocarbons to a limited degree in the groundwater phase below the LNAPL. Additionally, the presence of LNAPL is causing the geochemical dissolution of metals from the soil and in particular, causing higher than background concentrations of arsenic in the groundwater. The seasonal fluctuation of groundwater and the influence of the river on groundwater flow have impacted the dispersal LNAPL vertically in the soil profile and in the horizontal direction. For example, as the groundwater fluctuates from the seasonal low water elevation to the seasonal high, the LNAPL is smeared in the vertical direction in the soil profile. Furthermore, LNAPL floating on the water table is carried by groundwater advection and thus the plume extends further in the west and southwest direction.

The direction of groundwater flow observed at the Site (to the southwest) is consistent with the plume of LNAPL that has been delineated (see Figure 4-3) and the visible discharge of LNAPL to the river. Any sources of contamination originating from the former 500,000 tank, other fueling operations on the Bentcik property, or in the area of MW-11 would migrate southwest and would eventually enter the Potlatch property (and ultimately the river) due to the direction of groundwater flow. The LNAPL plume appears to be elongating along the shoreline, which could be the result of the groundwater/surface water interaction and may also be a result of the presence of the impermeable wall. It is possible that the LNAPL is flowing west along the impermeable wall and smearing along the soil at the water table and the shoreline. Nevertheless, some LNAPL is migrating through or underneath the impermeable wall and is discharging along the river bank during low river stages.

4.7.1.1 Monitoring Well Pressure Transducer

As discussed in Section 3, a pressure transducer was installed in monitoring well EW-4 in order to monitor the daily fluctuations in water level and to observe if any correlation between groundwater fluctuation and river level exists. Figure 3-4 is a hydrograph that displays the data collected from the pressure transducer, the manual groundwater levels for that well, and the manual stream gauge

measurements. The data indicates that the groundwater level in EW-4 is typically slightly higher than that at the stream gauge, which is understandable since the stream gauge is located down-gradient from EW-4. However, on occasion, the river level is slightly higher than the pressure transducer. This phenomenon may be attributable to the level of precision with the pressure transducer or the level of human error when reading the stream gauge, and not actually a physical condition. When comparing the data from both of these sources, it appears that they track well- when the river level has dropped, the water level detected by the pressure transducer drops too. This data supports the fact that the groundwater levels on-site are linked with the fluctuation of the river levels. The relationship between groundwater and river levels will be analyzed again in the spring after the seasonal high water levels are recorded by the pressure transducer and the stream gauge has been re-installed in the river.

4.7.2 Surface Water

The St. Joe River flows from the east to west along the Site's southern boundary. The Site is along a stretch of river that has a relatively low gradient compared to the river upstream. The closest river gauging station is in Calder, Idaho, located down-stream from the Site. At the Calder station,, during spring snow melts in May, river flows average between 7,000 and 8,000 cubic feet per second (cfs). In contrast, September river flows average between 400 and 500 cfs. St. Joe River levels can fluctuate more than 8 feet in stage height. The river response time to precipitation tends to be fast as indicated by observations made during the late summer when river levels fluctuations were visible after precipitation events. The data presented in Section 3 provides evidence for the assessment that groundwater is in direct hydraulic communication with the river.

Despite the linkage between groundwater and surface water and the observations of LNAPL discharging from the sub-surface to surface water, the constituents found in Site groundwater are not detected in surface water adjacent to the Site. Specifically, arsenic, iron, manganese, naphthalene, and 1-methylnaphthalene are groundwater COPCs, but none are considered surface water COPCs. The surface water COPCs are strictly limited to the LNAPL and constituents within the LNAPL. Furthermore, the surface water COPCs were detected in a limited area where LNAPL is visibly being discharged from the sub-surface during low water conditions. It is suspected that during high water conditions, when LNAPL is not discharging to surface water, there are no impacts to surface water above detection limits. This hypothesis will be tested during the spring 2010 surface water sampling event.

4.7.3 Sediment

The samples collected from RS-1 represent the up-gradient, background condition of sediment in the vicinity of the Site. The sediment sample collected 4 feet from the shoreline at RS-1 detected PCBs (Aroclor 1260), diesel and heavy oil, PAHs, and metals. Some of the PAH and metals detections exceeded initial screening levels. This indicates that there are sources up-gradient of the Site that are contributing petroleum products, PCBs, and PAHs to river sediments, and thus this is not a pristine riverine system in the area up-gradient to the Site. It is important to identify that the Site is down-stream

from the town of Avery, Idaho, which could be a source of these constituents. PCBs were not identified in any of the sediment samples collected from the on-Site river stations during the EE/CA investigation.

Impact to sediment at the Site is caused by LNAPL seeping from the sub-surface. The source(s) of LNAPL to the surface water and sediment has not been definitively determined, but observations made during reconnaissance activities in 2009 indicated LNAPL seeping from underneath a geotextile fabric that terminates at the shoreline. It is suspected that this geotextile fabric is one component of the impermeable wall installed by Hart Crowser in 2000. Furthermore, viscous, highly degraded oil was observed underneath cobbles along the shoreline and river bed up to 5 feet into the river. It is suspected that the sediment has become impacted by LNAPL over time during seasonal low water (groundwater and surface water) when the soil smear zone is exposed and LNAPL becomes mobilized in the groundwater discharging to the river.

4.7.4 Soil

Observations made during test pit and boring excavation coupled with sample results confirm the presence of free product in the soil smear zone (11 to 17 feet bgs) is contributing LNAPL to the groundwater. The presence of dissolved petroleum hydrocarbons, arsenic, iron, and manganese in groundwater only in wells within the known LNAPL plume is an indication of the soil to groundwater pathway within the smear zone of the Site during water table fluctuations. Nevertheless, groundwater in direct contact with LNAPL in soil is not necessarily contributing all contaminants to groundwater. For example, PCBs were identified in subsurface soils and in LNAPL samples, but have not been detected in groundwater. This indicates that although groundwater is in contact with LNAPL in soil, the PCBs are not being leached into the groundwater. The elevated concentrations of dissolved arsenic, iron and manganese metals in the water phase of groundwater within the LNAPL plume area strongly suggests preferential dissolution of these naturally-occurring metals from the soil to groundwater because of the local geochemical changes influenced by the presence of LNAPL. Furthermore, it is uncertain at this point if there is any PAH contribution from soil or LNAPL to groundwater because none of the EE/CA investigation groundwater samples had dissolved PAHs in the groundwater phase in excess of federal MCLs, but E & E samples collected in 2007 did. The April 2010 groundwater sampling event will help clarify the soil and LNAPL to groundwater pathway for PAHs.

There is the potential for future contribution of LNAPL sheen to the groundwater from vadose zone soils (ground surface to 11 feet bgs) as indicated by the results of sheen tests (Minnesota Pollution Control Agency, 2008) conducted on vadose zone soils above the smear zone (see Table 4-3). Highly impacted vadose zone soils have the potential to continue contributing LNAPL sheen to the water table into the future.

4.8 Nature of Potential Contamination

As discussed earlier in Section 4, the COPCs were defined by media and included: (1) diesel and heavy oil range petroleum products (LNAPL and water phases), benzo[a]pyrene, 1-methylnaphthalene, arsenic, iron, and manganese in Site groundwater; (2) diesel and heavy oil range petroleum products (LNAPL phase only), benzo[a]anthracene, and chrysene in Site surface water; (3) diesel and heavy oil range petroleum products, and PAHs for Site soils; (4) diesel and heavy oil range petroleum products, and PAHs in Site sediment; and, (5) PCBs, PAHs, and metals in Site LNAPL. The physical and chemical properties of these COPCs are presented in Table 4-2 and are discussed below.

4.8.1 Metals

Metals are ubiquitous and persist forever in the environment because they are naturally occurring elements. Arsenic was detected in Site near shore sediment and groundwater within the zone of impact at concentrations exceeding screening levels. Arsenic is a naturally occurring metalloid commonly found as a cation in compounds or as an arsenide and arsenate anion in compounds. Naturally occurring arsenic in soil can have a range of concentrations based upon the nature of the parent material. Arsenic is common in its natural form in many minerals. Naturally occurring pathways in the environment include volcanic ash, weathering of arsenic containing parent material, and groundwater. The solubility of arsenic is highly variable and depends on the arsenic containing- minerals present and the geochemical nature of the groundwater. Arsenic can be released from soil and rock into groundwater under anoxic conditions. This preferential dissolution can cause higher than background concentrations of arsenic in groundwater.

Antimony was detected in Site near shore sediment within the major zone of impact at concentrations exceeding screening levels. Antimony is a naturally occurring metalloid. Antimony is commonly associated with lead as an alloy due to its strength and hardness. Antimony is also a common component of petroleum (EPA Technical Fact Sheet). According to the EPA Consumer Fact Sheet, little is known about the fate of antimony once it is released to soil. There has been conflicting studies regarding its mobility in soils where some have identified it as highly mobile, while others have indicated it strongly adsorbs to soil. The strength of antimony's adsorption to soil is reliant upon a variety of conditions including the pH and organic content of the media. There is no evidence of most antimony compounds bioconcentrating in organisms. The solubility of antimony depends upon the particular mineral but can range from slightly soluble up to 4.4 kg/L at 20 degrees centigrade in water (EPA Technical Fact Sheet). Because antimony is a naturally occurring element, it will persist forever in the environment.

Iron was detected in Site groundwater within the zone of impact by free product at concentrations exceeding screening levels. Iron is a naturally occurring metallic element that is an essential nutrient (at low doses) for humans and animals. The solubility of iron in water depends upon the iron compounds, the oxygen level in the water, and the pH of the water. For example, Fe^{2+} is typically more soluble than Fe^{3+} and can solubilize more readily from the soil under reducing conditions that may be caused by the

presence of LNAPL. Iron can enter groundwater through weathering and dissolution from soil and bedrock (Oregon Department of Human Services, undated). Iron is a secondary drinking water standard because of its ability to alter the taste and staining of water. Because iron is a naturally occurring element, it will persist forever in the environment.

Manganese was detected in Site groundwater within the zone of impact by free product at concentrations exceeding screening levels. Manganese is a naturally occurring element that is an essential nutrient (at low doses) for humans and animals. Manganese is not found naturally in its elemental form, rather it is a part of many minerals. Typical manganese intake is through food, but drinking water can be a source as well (EPA, 2004b). According to the EPA (2004b) manganese is naturally occurring in surface and groundwater, and particularly in soils that may erode into water. Furthermore, this report identifies anaerobic groundwater often contains elevated levels of dissolved manganese. The solubility of manganese in water depends upon the form of manganese, but can range from insoluble (MnO_2 and $Mn_3O_{4)}$ to 723g per 100 mL at 25°C ($MnCl_2$). Manganese is considered a secondary water standard by EPA due to its ability to alter the taste and staining of water. Bioaccumulation of manganese can occur in lower aquatic organisms (e.g. algae and some fish) but not higher organisms (Agency for Toxic Substances and Disease Registry, 2000). Mobility of manganese in soil depends upon adsorption, which varies based on organic content and cation exchange capacity of soil (EPA, 2004b). Because manganese is a naturally occurring element, it will persist forever in the environment.

4.8.2 Petroleum Hydrocarbons

Petroleum hydrocarbons in the weathered diesel and heavy oil range were detected predominantly in the mid-to-lower soil across the western portion of the Site at concentrations exceeding screening levels. Diesel and heavy oil are composed of many straight-chained (aliphatic) and ringed (aromatic) hydrocarbon species. Diesel typically consists of C-10 to C-18 straight-chained and ringed hydrocarbons, whereas heavy oil typically consists of C-16 to C-30 straight-chained and ringed hydrocarbon. Diesel and heavy oil-range petroleum hydrocarbons are a liquid at Site temperatures, but have relatively low volatility. The heavier petroleum hydrocarbons (those with more carbon) are not readily dissolved in water. These hydrocarbons are typically not very mobile in soils and have high adsorption onto soils because of their high organic carbon to water partition coefficients (Koc). At high concentrations, they can exceed the soil absorption capacity and migrate as a liquid vertically through the soil column under gravity. Another potential migration pathway is the presence of diesel in free product causing the mixing and mobilization of the heavier oil fractions in the environment. The observation of free product containing both diesel and heavy oil in soil and on the groundwater table confirms these migration pathways at the Site. Vertical migration is typically limited by the underlying soil absorption capacity unless the release is continuous or is from a large sudden spill. Small surface spills typically do not migrate deep within soils as observed in the oil-stained soils at the Site. Table 4-1 shows physical and chemical properties for diesel and heavy oil.

Petroleum hydrocarbons as dense non-aqueous phase liquids (DNAPL) are not suspected to be present at the Site. It has been documented that some heavy oils can agglomerate to a solid that is denser than water and sink. Particularly this has been observed after marine oil spills. However, these are extremely heavy asphaltic materials that are in the solid phase and not liquid phase. These solids are not mobile because they have no flow characteristics, but can provide for dissolution into the surrounding water column. The solubilities of such heavy asphaltic petroleums are very low and would be manifested in the water phase groundwater samples from the Site monitoring wells.

4.8.3 PAHs

The physical and chemical characteristics of PAHs for the Site vary. PAHs are not considered volatile. PAHs have very low water solubility, generally in the single parts per billion range and is generally higher for the lighter PAH compounds than for the heavier compounds. According to the Washington State Department of Ecology Cleanup Level and Risk Calculation (CLARC) database, the aqueous solubility of carcinogenic PAHs can range from 0.022 µg/L up to 1.62 µg/L. Non-carcinogenic PAHs have an aqueous solubility ranging from 43 µg/L to 31,000 µg/L. The lighter PAH compounds, such naphthalene, degrade at a higher rate and are more mobile than the heavier range petroleum hydrocarbons. Naphthalene and related methylated naphthalenes are constituents of products likely used historically at the Site, but were not used as a pure product. PAHs are very persistent and are practically immobile by themselves, but can become more mobile when dissolved and carried within a lighter petroleum compounds. Table 4-1 shows physical and chemical properties for selected carcinogenic PAHs.

4.8.4 PCBs

PCBs are a group of organic compounds with a range of 1 to 10 chlorine atoms attached to two benzene rings (also known as a biphenyl). Formerly, PCBs were used as hydraulic fluids, fire retardants, lubricants, and in dielectric fluids, among other practical uses. PCBs are extremely persistent in soil and water because there are no known break-down processes (EPA Consumer Fact Sheet). Typically, PCBs do not leach to groundwater because of their ability to adhere to soil particles, but leaching of PCBs into surface water bodies has been documented. Due to their toxicity and persistence in the environment, PCB production was banned by the United States in 1976. The water solubility of PCBs Aroclors range from 0.057 mg/L up to 0.59 mg/L (IDEQ REM, 2004); however the CLARC database lists an aqueous solubility of 0.7 mg/L. The solubility can be high in organic solvents, oils, and fats. In electrical equipment manufacturing in the USA, Aroclor 1260 and Aroclor 1254 were the main mixtures used before 1950. Aroclor 1260 is the only aroclor detected on-site.

4.9 Physical Processes

The COPCs are subjected to several physical processes as they migrate through the subsurface environment including advection, dispersion, and molecular diffusion. Advection is the migration of a substance due to the bulk movement of water. Advection tends to move chemicals in the direction of flow (for example in the direction of groundwater flow). Hydrodynamic dispersion, which consists of both

mechanical dispersion and molecular diffusion, dilutes concentrations primarily in the direction of flow. Mechanical dispersion of ground water plumes is caused primarily by the movement of ground water around the soil particles that are in the flow path. These particles divert the forward motion of ground water and tend to disperse substances. Molecular diffusion, caused by Brownian motion and concentration gradients also causes chemicals to disperse and dilute in ground water. Therefore, as COPCs migrate, these physical processes, in combination with the chemical and biological processes, retard and dilute COPC concentrations in water along the infiltration and ground water pathways. One final physical process that may describe the migration of contaminants at the Site is the mobilizing effect that diesel has on heavy oil upon contact.

Infiltrating rainwater, and in some instances river water, comes into contact with soil containing COPCs at the Site. For pathways activated by contact of water with soil containing COPC (e.g., overland runoff and infiltration), the migration rate is controlled by the availability of water, the time of contact between the water and the constituents , the rate of evaporation, the permeability and wetting characteristics of soil and the vadose zone, and the solubility of the COPCs. The relative partitioning of COPCs between the dissolved and particulate phases are controlled by a complex combination of precipitation, dissolution, and sorption reactions.

Sorption is an important process affecting metals migration for infiltrating rainwater and ground water. Sorption can be thought of as an equilibrium-partitioning process between the soil and water.

4.10 Data Gaps

At the completion of the EE/CA investigation, several data gaps have been identified. These data gaps were identified after analyzing and interpreting current and historical data that has been collected at the Site. The investigation of the following data gaps may provide additional Site information, but the missing data is not mandatory for finalizing this EE/CA and selecting a treatment alternative.

- The depth and lateral extent and source of contamination in river sediment.
- Refined estimation of hydraulic conductivity of the aquifer in the form of a long-term pump test. This is only necessary for removal alternatives involving hydraulic control.
- The extent of contamination below Highway 50. This information is only pertinent to removal alternatives involving excavation.
- Groundwater analytical data collected during seasonal high water. No groundwater data has been collected during the seasonal high water period using a drop tube or other similar sampling method to eliminate the risk of LNAPL carry-down into the sample. This data is important for adequate interpretation of the condition of the aquifer and aquifer discharge to the St. Joe River during the seasonal high water period.
- Plume delineation west of TP-8 near the shoreline. No test pits were excavated west of TP-8 and therefore the boundary of the plume cannot be completely established, only estimated. This information is not necessary to establish a treatment alternative.
- Collect additional surface water samples adjacent to the shoreline during a high flow period to confirm the quality of the surface water in the dissolved phase.

5.0 STREAMLINED EE/CA RISK EVALUATION

This section presents a summary of the Human Health Risk Evaluation (HHRE) and the Ecological Risk Evaluation (ERE) for exposures to Site media impacted by COPCs. The Site COPCs by media were determined in Section 4. The purpose of the HHRE and ERE is to determine if the Site COPCs pose unacceptable risks to receptors at the Site in its current state (without removal actions), and if so, to define those constituents and media that need to be addressed to eliminate unacceptable risks. The results of this section will be used to develop Removal Action Objectives (RAOs) in Section 6.

5.1 Human and Ecological Receptors and Exposure Pathways

The HHRE and ERE evaluate potentially complete exposure pathways for impacted media at the Site that can reach human or ecological receptors, and then characterizes whether the exposures pose an unacceptable risk. For humans, both cancer and non-cancer risks associated with the exposure pathway are evaluated in accordance with the Idaho Risk Evaluation Manual (REM) (IDEQ 2004). For ecological risk, COPC media-specific concentrations that represent a potential adverse health effect to receptors were evaluated in the ERE. A Conceptual Site Model (CSM) for the Site is shown on Figure 5-1, which identifies the potential human and ecological receptors and operative exposure pathways to these receptors. Ultimately, the HHRE and ERE will determine the constituents of concern (COCs) in each media for Site receptors, which will be considered during development of potential removal actions.

5.1.1 Risk Screening Levels

Screening levels were derived based on federal and state human health and ecological toxicity criteria and are used to screen the media at the Site for potential risks. Media having COPCs that are above the screening levels were considered further in a HHRE and ERE; whereas, media not containing COPCs above screening levels were not considered to pose a risk and were not further evaluated in the HHRE or the ERE.

Potentially applicable risk-based concentrations for human receptors were identified for soil, sediment, and water in Tables 3-1, 3-2, 3-6, 3-7, 3-9, and 3-10 from federal and Idaho state criteria. Screening levels or cleanup levels cannot be below background or analytical PQLs for standard EPA and Idaho accepted analytical methods. The selected human screening levels for each COPC represent the lowest value among the federal or state risk-based criteria. If the laboratory analytical PQL or Site-specific background levels are above the screening level, the PQL or background values become the default screening level. The COPCs that are above screening levels in Site media are provided by media in Table 4-1.

5.1.2 Receptor and Exposure Evaluation

Information concerning potential receptors and exposure pathways, including chemical sources and chemical constituent release mechanisms, are integrated into the CSM (Figure 5-1). The CSM provides a framework for problem definition, defines the framework for the risk assessment, and assists in identifying

response actions for the Site, if necessary. A CSM is typically based on current information available, but is dynamic and can change as new information becomes available for a site.

The CSM for the Site is presented in Figure 5-1 and reflects current and reasonable future land uses of the Site. The potential sources, affected media, release mechanisms, and routes of exposure presented in the CSM represent the suspected sources of petroleum and other substance releases at the Site and are identified on the basis of historical information, previous Site investigations provided in Appendix G (E & E 2007), and the results of the investigations conducted for this EE/CA. EE/CA Site investigation activities and previous investigations are presented in Sections 2 and 3 of this EE/CA Report.

5.1.2.1 Potential Receptors

The following current and future receptors may be exposed to Site metals and were included as potential receptors in the CSM (Figure 5-1):

- Current (Bentcik residence only) and potential future on-Site residents. The only current resident on-Site is the Bentcik residence, who is an owner of the eastern portion of the Site that occasionally uses an on-Site home
- Current and future on-Site recreational visitors or trespassers
- Future construction workers

The CSM (Figure 5-1) presents the current and future ecological receptors that may be exposed to Site COPCs:

- Terrestrial wildlife
- Aquatic organisms in the St. Joe River

5.1.2.2 Potential Receptor Exposure Pathways

A complete exposure pathway is defined by the following four elements (EPA, 1989):

- A source of chemical release into the environment
- An environmental medium for transport of the chemical (e.g., air, ground water, or soil)
- A point of potential exposure for a receptor
- A route of exposure for the receptor (e.g., ingestion inhalation or dermal contact)

An exposure pathway is considered complete or potentially complete when all four of these elements are present. All potential human health exposure pathways for the media of concern depict primary and secondary release mechanisms, retention-exposure mechanisms, and potential exposure routes.

Complete and potentially complete exposure pathways were identified by comparing media concentrations to screening values and are presented in the CSM (Figure 5-1). A discussion of the main potential exposure pathways are presented in the following sub-sections.

I. Soil Exposure Pathway

Current and future residents and recreational visitors/ trespassers could potentially be exposed to near surface Site soils. Future on-Site construction workers could become exposed to Site near surface and subsurface soils during construction or removal activities. Terrestrial wildlife can also become exposed to the Site's near-surface soils. COPCs for Site soils are petroleum hydrocarbons and PAHs, both of which may pose an unacceptable risk to these receptors. Exposure pathways include incidental ingestion, dermal contact, and inhalation of fugitive dust from Site soils. Consequently, these receptor groups are addressed in the HHRE and ERE for potential exposures to Site soils.

II. Groundwater Exposure Pathway

Groundwater at the Site exists in the colluvium/alluvium soils and in the bedrock. Groundwater is between 10 and 15 feet below land surface at the Site. Groundwater discharges to the St. Joe River along the Site's bank, which is armored with large rip-rap rock. Therefore, terrestrial wildlife are not exposed to Site groundwater. The only manner in which current or future humans can become exposed to Site groundwater is by extracting groundwater from on-Site wells for ingestion (drinking or cooking) and bathing (dermal contact). Depending on the location of the groundwater extraction well and the installation of the groundwater supply system, the potential exists for groundwater use to contain LNAPL COPCs, including diesel, heavy oil, PAHs, PCBs, and arsenic.

Currently, there is one groundwater supply well at the Site, designated as DW-01. This well was used by a small community of on-Site residents in the past. There are no longer full-time on-Site residents and DW-01 is currently not in use. The power supply to the DW-01 pump system has been removed making the water supply system operative. The part-time Bentcik residence in the eastern portion of the Site obtains their yard and livestock water supply from a spring located north of Highway 50 in the gulley about 50 feet in elevation above the location of the former 500,000 gallon fuel tank. The Bentcik water supply system captures spring water off-Site and conveys the captured water by gravity through a pipeline to an above ground holding tank on the Bentcik Property. Bottled water is used for human consumption on the Bentcik property. Therefore, there is no current potential for human exposure to Site groundwater by the part-time Bentcik residence. In the future, groundwater may be used as the drinking water supply if the Site land-use changes or the water supply for the Bentcik property changes.

III. Groundwater to Surface Water Exposure Pathway

The potential for groundwater to adversely impact surface water depends on the concentration of COPCs and the flux of groundwater discharging to the river. The groundwater containing LNAPL is considered a continuing threat to surface water due to the fact that LNAPL is visibly discharging to the river and contains PAHs. This evaluation considers whether the water phase of Site groundwater is a material threat to surface water using two approaches as follows:

1. Average groundwater concentrations that discharge to surface water are compared to surface water quality standards (IDAPA 58.01.02). Average concentrations are used for COPCs because the discharge of groundwater to the river is an area source and its flow and discharge location vary by season and rapid river water level changes. Single well groundwater concentrations were used for determining COPCs in groundwater for human potable uses, because a supply well potentially could be installed at any location on the Site. The arithmetic average of the groundwater analytes (arsenic, thallium, benzo(a)anthracene, and chrysene) concentrations do not exceed the Idaho surface water quality standards (IDAPA 58.01.02) for all beneficial uses (aquatic life, human consumption of aquatic organisms and potable water supply), except for arsenic. Arsenic concentrations average 11 µg/L in Site groundwater and the proposed new Idaho surface water standard is 10 µg/L (current standard is 50 µg/L). The estimated discharge of groundwater from the Site to the river is about 0.5 gallons per minute (calculated from an average groundwater velocity of 0.02 feet/day {Section 4.7.1}, effective porosity of 0.25, 10 feet of aquifer thickness, and 1500 feet of shoreline discharge). The low flow condition of the river has a flux of surface water on the order of 180,000 gallons per minute. It is difficult to determine that Site groundwater (water phase) discharge to the river represents a material threat to the river with this evaluation, especially considering the mixing of river water with groundwater in the hyporheic zone before actual discharge to the river.

2. The actual surface water concentrations analyzed were from surface water samples collected during a low-flow period from along the shoreline of the Site. The Idaho surface water standards for the highest beneficial use of the river include aquatic life, recreation and water supply. The appropriate surface water quality standard is for human consumption of water and organisms that are also protective of aquatic life (IDAPA 58.01.02). The river surface water samples obtained during the EE/CA investigation only had one sample of the total eight surface water samples collected that contained any analyte above Idaho standards for all beneficial uses. The analytes include benzo(a)anthracene and chrysene at twice and 4 times, respectively, the Idaho standard for all uses. (Note: the reporting limit was greater than the Idaho standard for carcinogenic PAHs, but the method detection limit was lower than the Idaho standards). The single surface water sample that contained COPCs above Idaho standards was below LNAPL on the surface of the water, the results of which may actually be caused by dissolution or carry-down from the LNAPL rather than from groundwater (water phase only) discharges. The Idaho surface water standard for protection of aquatic life and human ingestion of aquatic organisms was not exceeded by any analyte in any surface water sample.

Using the two evaluation approaches above, the discharge of Site groundwater (water phase only) does not represent a material threat to the river and is not considered further in this risk evaluation.

IV. Surface Water Exposure Pathway

Surface water is a potential exposure pathway to humans and ecological receptors at the Site. Groundwater discharges to the St. Joe River along the bank of the Site. The groundwater discharges dissolved water-borne COPCs as well as the floating LNAPL containing petroleum hydrocarbons and PAHs. The dissolved constituents in the water phase are present at concentrations lower than screening levels for human and aquatic receptors. However, the dissolved PAHs present at river station RS-4 are above screening levels for humans using this surface water for drinking and bathing and eating aquatic organisms from this portion of the river. The LNAPL discharges to the river and contains COPCs that may pose a risk to human and ecological receptors (see Table 4-1). Although the LNAPL in portions of

the on-Site groundwater table have detectable PCBs, these constituents were not detectable in the LNAPL that discharges to the river. Presumably, the PCBs are attenuated by soil adsorption more than other constituents of the LNAPL.

The human exposure pathways for surface water COPCs include: ingestion of surface water, ingestion of aquatic species residing in the surface water, and dermal exposure by swimming or wading. The ecological exposure pathways for surface water COPCs include: ingestion of surface water, ingestion of aquatic species in the food chain that may have been exposed to COPCs, and dermal exposure.

V. River Sediment Exposure Pathway

Current and future residents and recreational visitors/ trespassers can be exposed to Site river sediments by direct contact while swimming or wading. Ecological receptors are also exposed to Site river sediments through direct contact and ingestion of aquatic food containing Site sediment COPCs. Future on-Site construction workers could also become exposed to Site river sediments during construction or removal activities. Site river sediment COPCs are petroleum hydrocarbons and PAHs, both of which above screening levels and may pose an unacceptable risk to these receptors. Consequently, these receptor groups are addressed in the HHRE and ERE for potential exposure to Site river sediments.

VI. Air Exposure Pathway

The COPCs at the Site have no or very low volatility and do not pose a risk through inhalation by vapor emissions to the atmosphere or vapor intrusion into current or future buildings. Surface soils at the Site represent impacted media that may release COPCs through fugitive dust emissions. There is limited vegetative cover on surface soils, which makes these materials more amenable to fugitive dust emissions. However, the Site surface soils are comprised of fill materials that are coarse grained and are not subject to significant fugitive dust emissions. Although surface soils are not considered to be amenable to significant fugitive dust emissions, the air exposure pathway for humans is retained as an operative mechanism for exposure.

5.2 Baseline Risk Evaluation

The baseline HHRE and ERE were completed separately. The HHRE only considers potential human exposures to media having COPCs and the ERE focuses on ecological receptors to specific media (soils or river media) having COPCs.

5.2.1 Baseline Human Risk Evaluation

The HHRE approach is performed either through comparison with regulatory health-based promulgated standards or through a risk characterization performed in accordance with EPA Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Risk Assessment Guidance (RAGS – EPA, 1989) and the State of Idaho Risk Evaluation Manual (IDEQ 2004). In the case of an exceedance of a promulgated health-based regulatory standard, then a potential unacceptable human risk is identified.

In the case where a COPC in a specific media does not have a promulgated health-based regulatory standard, risk is characterized through cumulative risk assessment models using acceptable and conservative input parameters and exposure scenarios. The cumulative health risk is calculated to determine non-cancer hazards and the excess lifetime cancer risks. The COPC concentrations used in the baseline HHRE are called exposure point concentration (EPCs) and are either the maximum detected COPC concentration or the statistical average for each media.

5.2.2 Baseline Human Risk Characterization

5.2.2.1 Site Soil Risks to Humans

I. Current and Future Residents

The cumulative risk calculations for the current and future residential scenario exposed to Site soils are provided in Appendix I. Chronic, non-cancer risk was evaluated by the calculation of the hazard quotient (HQ) for exposure to each constituent, and a total cumulative Hazard Index (HI) for contaminant exposure to non-carcinogenic COPCs in Site soils (non-carcinogenic PAHs). Idaho considers a cumulative HI score of 1.0 acceptable for sites conducting a Risk Evaluation Level -1 or 2 (IDEQ 2004). Cancer risks were evaluated by calculating the probability for cancer to develop from specific carcinogenic substances in Site soils (carcinogenic PAHs) for concomitant types of exposures at the Site. Cancer risk represents the individual excess lifetime cancer risks (IELCR) that occurs due to exposure to the Site carcinogenic substances. IELCR is presented as the number of individuals that potentially would develop additional cancer (over what is normal) for a given population. Idaho considers an IELCR of less than 1 out of 100,000 people (10^{-5}) exposed to carcinogens at the Site acceptable, when conducting a Risk Evaluation Level -1 or 2, when cumulative contaminant effects are considered (IDEQ 2004).

The cumulative risk model and calculations are presented in Appendix I for the residential scenario. The model considered exposures to a full-time residential child and adult as the human receptors exposed to COPCs in the near-surface soil. The model was run using individual near-surface soil samples that had the highest concentrations of individual COPCs from both the EE/CA investigation and the previous EPA investigation in 2007. The maximum concentrations used for the EPC in the model are shown in Table 4-1. The modes of exposure to Site soils in the model included: incidental ingestion, dermal contact, and inhalation of potential fugitive dust. The exposure input values used in the models were the default values suggested in the REM (Idaho 2004). As presented in Appendix I, full-time residential human exposure to Site soils has a maximum HQ of 0.11 and a maximum IELCR of 1.17E-05, when the maximum COPC concentrations are assumed for exposure. Therefore, Site soils do not represent a non-carcinogenic risk to current or future residents, but may pose an unacceptable cancer risk to children that live full-time at the Site. Any part-time residence at the Site does not pose an unacceptable cancer risk.

II. Current and Future Recreational Visitor/Trespasser and Construction Workers

Based on the results of the baseline HHRE for residential exposures to Site near surface soil, the potential exposure to occasional visitors or trespassers and short-term exposures to construction workers would be much lower in frequency and duration. Although the model was not run for calculating potential risk to the recreational visitor/trespasser and construction worker scenario, the risks have lower HQs and IELCRs for these human receptors to Site soils than associated with a resident receptor. Therefore, this HHRE determined that non-carcinogenic and carcinogenic risks from Site soils to human receptors other than residents are acceptable.

5.2.2.2 Site Groundwater Risk to Humans

Site groundwater is not used by current/future recreational visitors or by future construction workers because it is 10 to 15 feet bgs. Therefore, there is no risk to these human receptors by groundwater. Site groundwater is currently not used by the part-time residents because their drinking water is obtained from an off-Site spring, as discussed earlier in this Section 1.1.2.2.2. The potential for future use of Site groundwater exits if new residences are developed on the Site or the Bentcik property water supply changes to groundwater. The groundwater in portions of the Site having LNAPL present on the water table contains not only diesel and heavy oil range petroleum hydrocarbons, but also multiple carcinogenic and non-carcinogenic PAHs and PCBs (Aroclor 1260). In the area of the LNAPL, groundwater has dissolved arsenic concentrations above Federal and State of Idaho Primary Maximum Contaminant Levels (MCLs). Therefore, use of groundwater for human consumption at the Site represents an unacceptable risk. Outside of the area impacted by LNAPL, the groundwater does not represent an unacceptable risk to humans.

5.2.2.3 Site Surface Water Risk to Humans

The surface water adjacent to the Site contains dissolved COPCs as well as LNAPL. Human risk from the Site surface water is evaluated separately for the dissolved COPCs in the water phase and the LNAPL floating phase. The surface water along the shoreline contains dissolved COPCs that are below promulgated regulatory standards (i.e., MCLs) for human use as drinking water. COPCs detected in the water phase (excluding the LNAPL released to the near-shore river) at RS-4 included two potentially dissolved carcinogenic PAHs {benzo(a)anthracene and chrysene} above Idaho surface water quality standards (IDAPA 58.01.02) for humans using the surface water as a drinking and bathing water source, and consuming the aquatic organisms living in the impacted surface water. The RS-4 surface water sample was the only surface water sample collected during the EE/CA investigation that had dissolved COPCs above surface water quality criteria for humans. Although the St. Joe River is protected for domestic water use, there are no public water supply intakes in the area of the Site. The water phase analytical results for all Site near-shore surface water samples (including RS-4 sample) are below Idaho surface water standards identified for humans consuming aquatic organisms, but not using the surface water as a water source. The presence of these dissolved carcinogenic compounds does not pose an unacceptable risk to potential future residents because the impacts from dissolved Site COPCs are

isolated at one near-shore station. Occasional recreational visitor/trespasser and the future construction worker use of the river at the Site as a drinking water source and consumption of aquatic organisms from along the Site near-shore surface water do not pose an unacceptable risk due to the limited frequency and duration of exposure.

A floating product in the LNAPL phase was present between river stations RS-2 and RS-6 during low river water level periods. It has been identified that floating product in the LNAPL phase is not present at the Site during high river water level periods. The LNAPL contained detectable diesel and heavy oil petroleum hydrocarbons and multiple carcinogenic and non-carcinogenic PAHs, but no PCBs. The risk is difficult to calculate using the Idaho REM for the presence of seasonal LNAPL discharges. Nevertheless, the use of near-shore surface water containing LNAPL for daily consumption and use probably represents a potential human health risk. Incidental ingestion and direct dermal contact by occasional recreational visitors/trespassers or by short-term construction workers are not expected to represent an unacceptable risk because of the frequency and duration of their potential exposure to the LNAPL.

5.2.2.4 Site River Sediment Risk to Humans

Near-shore Site river sediment COPCs are diesel and heavy oil petroleum hydrocarbons and PAHs. The concentrations of sediment COPCs are similar or lower than the most impacted near-surface Site soils that were used to estimate risk in the above Section for Site residents. A full-time resident, recreational/trespasser or a construction worker may be exposed to near-shore river sediments by swimming and wading or working during the excavation of the impacted sediments. Such exposures would be at a lower frequency and duration then assumed for exposures to on-Site soils by full-time residents (on-Site soils exposures were assumed to be daily for residents). Because the river sediment COPCs are at comparable or lower concentrations than Site near-surface soils, and human exposures are less than those assumed for a full-time resident, the near-shore Site river sediments do not represent an unacceptable risk to human receptors based on the calculated risk to residents from Site near-surface soils.

5.2.3 Constituents and Media of Concern for Humans

The only human risk that is deemed unacceptable is for on-Site, full-time human residents. Groundwater and LNAPL-containing surface water used by humans for drinking and bathing pose a potential unacceptable risk. Any full-time residential use of the Site would need to obtain water from alternative sources such as the bottled water used at the Bentcik residence. This risk level for residential exposure is marginal for Site near-surface soils having an IELCR of 1.17E-05 using the most-conservative maximum concentrations of COPCs analyzed in all the near-surface soils. If an average concentration were used in this risk evaluation for the near surface soils rather than maximum concentrations, the calculated risk is expected to be lower. In addition, even using the most-conservative COPC concentrations, the risk assumes that the resident resides full-time on-Site. For example, part-time

residence on-Site, such as the Bentcik property, would not pose an unacceptable risk to humans from near-surface soil exposures.

Based on this conservative HHRE using the maximum detected COPC concentrations, the Site media and constituents of concern (COCs) include:

- **Groundwater** - LNAPL (containing petroleum hydrocarbons, PAHs and PCBs), dissolved arsenic, dissolved iron, dissolved manganese, and carcinogenic PAHs in the water phase.
- **Near-surface soils** - carcinogenic PAHs (full-time residents only).

5.3 Ecological Risk Evaluation

This ERE evaluates potential health risks separately for terrestrial wildlife and aquatic species. The ERE has been streamlined and compares media-specific Idaho promulgated regulatory standards for ecological protection, other state's relevant promulgated media standards, and federal guidance when state promulgated regulatory standards do not exist. A detailed quantitative ecological risk assessment would only be needed if the results of this streamlined approach identify sufficient risk uncertainty for a medium to develop appropriate RAOs.

5.3.1 Ecological Receptors

The Site is in mountainous terrain in northern Idaho. Many terrestrial and aquatic species exists in the area. The USFWS identify the Bull Trout as the only listed threatened or endangered species in the region. The USFWS also identified the upper St. Joe River in the vicinity of the Site as critical Bull Trout habitat.

The IDFG also lists the Bull Trout as a Federally-listed threatened species in the Site region. IDFG identifies two species of concern in the region of the upper St. Joe River:

- The Westslope Cutthroat Trout
- The Coeur d'Alene Salamander

Other terrestrial wildlife and aquatic species of interest in the region include: elk, mule and white-tailed deer, black bear, forest grouse, grey wolf, coyotes, bobcats, song birds and raptors.

5.3.2 Terrestrial Wildlife ERE

The CSM (Figure 5-1) identified potential operative Site exposure risks to terrestrial wildlife by:

- Direct contact (dermal and incidental ingestion) to the Site's near surface soils
- Drinking of surface water.

The State of Idaho has not promulgated risk-based soil standards for the protection of terrestrial wildlife. The State of Washington has promulgated standards that are considered protective of terrestrial wildlife to soils in their MTCA regulations (WAC 173-340-7493 (MTCA Table 749-3). The Site COPCs in which

MTCA regulations have promulgated soil standards that are protective of both avian and mammalian species include:

- Carcinogenic PAHs represented by benzo(a)pyrene at 12 mg/kg (equivalent for all carcinogenic PAHs)
- Diesel range petroleum hydrocarbons at 6,000 mg/kg

The maximum concentrations of the Site near-surface soils (Table 4-1) are below these relevant MTCA promulgated standards. Therefore, the Site near-surface soils do not represent an unacceptable risk to terrestrial wildlife.

The risk to terrestrial wildlife drinking surface water adjacent to the Site is difficult to evaluate. The near-shore surface water phase of the river meets very stringent aquatic screening levels, but it is uncertain whether the presence of discharging LNAPL containing petroleum hydrocarbons and PAHs poses an unacceptable risk. It is expected that terrestrial wildlife will avoid direct consumption of the LNAPL, when surface water without LNAPL is readily available nearby. In addition, the percentage of time that terrestrial wildlife will actually drink surface water adjacent to the Site having LNAPL is dependent on their range. For these reasons, the risk to terrestrial wildlife from drinking surface water with LNAP is not expected to pose a significant and unacceptable risk.

5.3.3 Aquatic Wildlife ERE

The St. Joe River is a designated United States wild and scenic river and is classified by Idaho (IDAPA 58.01.02) as a cold water community (COLD), with salmonid spawning (SS) where the primary contact is recreational and is also protected as a domestic water supply. The CSM (Figure 5-1) identified potential operative Site exposure risks to aquatic Ecological receptors exposed to:

- Direct contact with surface water
- Direct contact with river sediments and ingestion of organisms that were exposed to the river sediments.

5.3.3.1 Surface Water Ecological Risks

The surface water adjacent to the Site contains dissolved COPCs in the water phase as well as a discharging LNAPL. Aquatic ecological risk from the Site surface water is evaluated separately for the dissolved COPCs in the water phase and the LNAPL floating phase. The analytical results of the Site near shore surface water samples did not have any COPC detections above Idaho surface water quality acute or chronic standards (IDAPA 58.01.02) for aquatic organism exposure. Therefore, the Site surface water phase does not represent an aquatic ecological risk.

The Idaho surface water quality standards (IDAPA 58.01.02.200.05) states:

> "Surface waters of the state shall be free from floating, suspended, or submerged matter of any kind in concentrations causing nuisance or objectionable conditions or that may impair designated uses.

This standard is subjective and not necessarily risk-based. However, this is an applicable regulatory standard for the St. Joe River. Therefore, the floating LNAPL petroleum phase discharges to the river from the Site groundwater may be considered a nuisance and objectionable.

5.3.3.2 Sediment Ecological Risks

Idaho does not have promulgated fresh water sediment standards. This ERE compares EPA Freshwater Sediment Screening Benchmarks (EPA 2006) to the analytical concentrations for the Site sediment samples. These EPA Screening Benchmarks are based on a consensus from several sediment quality studies for ecological protection (MacDonald, et. al. 2000) and were chosen by the EPA to represent potential risk levels. These screening benchmarks are presented in Table 5-1 and differ from the sediment screening levels used for COPC identification in Section 4, because they do not necessarily represent the most stringent (lowest concentration) levels found in the literature. The COPCs for Site sediments include PAHs, diesel and heavy oil (Table 5-1). The EPA does not list diesel and heavy oil in their Sediment Screening Benchmark document, nor has a suitable freshwater sediment standard been found for diesel and heavy oil in the literature. As presented in Table 5-1, the maximum diesel and heavy oil concentrations detected in Site samples were 8,830 mg/kg and 6,980 mg/kg, respectively for diesel and heavy oil in sediment collected near the shoreline at RS-4. All other Site sediment samples had diesel and heavy oil at concentrations less than 1000 mg/kg (most less than 200 mg/kg). The Site specific background samples from river station RS-1 contained diesel and oil concentrations greater than 500 mg/kg, with detectable PAHs and PCB aroclor 1260. Therefore, the background river sediments have been impacted from off-Site anthropogenic sources not attributable to the Site. Sediment samples from RS-3 and RS-4 stations were the only Site sediment samples that exceeded the background levels for diesel and oil.

The EPA Sediment Screening Benchmark for total PAHs is 1.61 mg/kg. The only Site sediment samples that exceeded this total PAH benchmark were from RS-3, and RS-4. Several individual PAH compounds exceeded the EPA Sediment Screening Benchmarks as shown in Table 5-1, but are localized in the area around RS-3, RS-4, and RS-5 river stations. Therefore, the sediment in the vicinity of RS-3, RS-4 and RS-5 represent a potential unacceptable risk to aquatic organisms.

5.3.3.3 Constituents of Ecological Concern

Based on this conservative ERE using the maximum detected COPC concentrations, the Site media and ecological COCs include:

- **Surface water** - floating LNAPL (containing petroleum hydrocarbons and PAHs)
- **Sediment** - diesel, oil and total PAHs in the vicinity of RS-3, RS-4 and RS-5

6.0 REMOVAL ACTION OBJECTIVES

This Section presents the initial components of the EE/CA removal action evaluation for the Site, as follows:

- **Development of removal action objectives and goals.** Objectives and cleanup level goals are established that provide the basis for developing and evaluating alternatives for the removal action at the Site.

These components are presented in the following Sections. Removal alternatives are assembled in Section 7, and developed from the retained technologies in Section 8, and evaluated in Section 9.

6.1 Development of Remedial Action Objectives

Removal action objectives (RAOs) are Site-specific goals based on acceptable exposure levels that are protective of human health and the environment and consider applicable or relevant and appropriate requirements (ARARs). RAOs combine consideration of ARARs and the specific constituents, affected media, and potential exposure pathways of a Site as determined through a preliminary risk assessment. The applicable major Site ARARs include:

- Federal Primary Drinking Water Standards)
- IDEQ Water Quality Standards
- Idaho Environmental Protection and Health Act
- Hazardous Waste Management Act of 1983
- Idaho Solid Waste Facilities Act
- Resource Conservation and Recovery Act
- Toxic Substances Control Act
- National Pollution Discharge Elimination System

Appendix H contains a comprehensive list of ARARs applicable to the Site as well as a brief summary description of each ARAR. RAOs identify risk pathways that removal actions should address, and identify acceptable exposure levels for residual COCs.

6.1.1 Human and Ecological Risk Pathways

6.1.1.1 Potential Human Risks

The streamlined human risk evaluation presented in Section 5 identified a small, potential unacceptable risk to future, full-time, resident children attributable to exposure (ingestion and direct contact pathways) to the worst case near-surface soils on-Site. There is no unacceptable risk to future, full-time resident adults, part-time residential use, current or future recreational visitors/trespassers, future construction workers, or off-site residents. It is not anticipated that fugitive dust emissions from the Site affected soils are significant.

The evaluation of Site data in Section 5 indicated that the Site groundwater and near shore surface water represent a risk to human health only where LNAPL is present and when the water is used as a domestic water supply.

6.1.1.2 Potential Ecological Risks

The results of the streamlined ecological risk evaluation of the data in Section 5 indicated that the likelihood of adverse effects of terrestrial wildlife exposed to Site near-surface soils with concentrations of COCs are low.

Exposure of aquatic ecological receptors to LNAPL on the surface water presents the likelihood of adverse effects. The near-shore surface water phase does not have dissolved constituents that represent a potential risk to aquatic organisms. No other Site surface water presents an unacceptable risk to aquatic ecological receptors, other than LNAPL impacted surface water within a limited area at the Site.

6.2 Removal Objectives

The Objective of removal actions is to eliminate or sufficiently reduce exposure pathways that represent a potential unacceptable risk to receptors. The RAOs specific for the Site include:

- Reduce exposure of potential future full-time residents to contaminated near-surface soils via direct contact and ingestion pathways. The COCs for surface soil are carcinogenic PAHs. The target cleanup levels will be such that after the removal action, the average cumulative carcinogenic PAH soil concentrations should not exceed an IELCR of $1x10^{-5}$.
- Reduce exposure of potential future full-time residents to direct contact and ingestion of groundwater and near-shore surface water impacted by LNAPL. The COCs for groundwater are the LNAPL (containing petroleum hydrocarbons, PAHs, and PCBs), dissolved arsenic, iron, manganese, and carcinogenic PAHs in the water phase. The near-shore surface water COC is the LNAPL, which contains petroleum hydrocarbons and PAHs. The cleanup standards that will be applicable to groundwater and surface water are the state and federal MCLs.
- Protect surface water from LNAPL releases and thereby reduce direct contact and ingestion exposure of human and aquatic organisms to LNAPL on surface water. Water phase contaminants in groundwater have not adversely affected surface water; therefore, groundwater containment or cleanup is not needed as an RAO for the protection of surface water. The surface water COC is the LNAPL and its contents, which include petroleum hydrocarbons and the PAHs. The cleanup standards that will be applicable to surface water are the state water quality standards (IDAPA 58.01.02).
- Reduce ecological direct contact and ingestion exposure to impacted sediments in the St. Joe River. River sediment COCs are diesel, heavy oil, and PAHs. The cleanup standards that will be applicable to sediment are the EPA Freshwater Sediment Screening Benchmarks (EPA 2006).

7.0 IDENTIFICATION AND SCREENING OF REMOVAL TECHNOLOGIES

This section identifies and screens removal technologies for use in assembling removal alternatives. Technologies are grouped by general response actions, as discussed below.

7.1 General Response Actions

General response actions are broad categories of removal actions that can be combined to meet RAOs at a site. The following general response actions are generally applicable to most sites, including the Potlatch Avery Landing Site:

- No action
- Institutional controls (including monitoring)
- Monitored Natural Attenuation (MNA)
- Containment
- Removal
- Ex-Situ Treatment (including reuse and recycling)
- In-Situ Treatment
- On-Site Disposal
- Off-Site Disposal

Except for "no action," each of these response actions represents a category of technologies. The applicable technologies will vary depending on the media and COCs.

7.2 Identification and Screening of Technologies

This section identifies and screens technologies that may be included as part of removal alternatives. A comprehensive list of technologies and process options to address the affected media and chemicals of concern is developed to cover all the applicable general response actions. The list of technologies is then screened to develop a refined list of potentially feasible technologies that are used to develop removal alternatives.

The removal technologies are screened using the following criteria:

- **Effectiveness –** The potential effectiveness of the technology to (1) address site-specific conditions, including applicability to the media and COCs for this Site, (2) achieve RAOs, (3) minimize human health and environmental impacts during implementation, and (4) provide proven and reliable remediation under Site conditions.
- **Implementability –** The technical and administrative feasibility of implementing a technology. Technical considerations cover site-specific factors that could prevent successful use of a technology, such as physical interferences or constraints, practical limitations of a technology, and soil and aquifer properties. Administrative considerations include the ability to obtain permits and the availability of qualified contractors, equipment, and disposal services.
- **Cost –** The capital and operation and maintenance costs associated with the technology. Costs that are excessive compared to the overall effectiveness of the technology may be

considered as one of several factors used to eliminate technologies. Technologies providing effectiveness and implementability similar to that of another technology by employing a similar method of treatment or engineering control, but at greater cost, may be eliminated. At the screening level, the cost evaluation is based on engineering judgment of relative costs.

The technologies and process options are screened against the criteria in the priority order listed above using the "fatal flaw" approach. This approach ranks the criteria in order of importance, as listed above. Once a technology is rejected based on effectiveness, it is not evaluated further (i.e., based on implementability or cost). Similarly, if a technology is effective, but not implementable, the technology is rejected and evaluation of cost is not undertaken. This approach streamlines the evaluation of technologies while maintaining the EPA screening methodology.

Evaluation and screening of technologies are performed in a single step. The key criterion in selecting the screening level (technology class, individual technology, or process option) is whether there is a significant difference between the technologies or process options when evaluated against the screening criteria (effectiveness, implementability, and cost). Technologies and process options that are judged to have significant differences are screened separately, and the retained technologies or process options will be developed into separate removal alternatives to allow full evaluation and comparison.

Process options retained for any given technology that are screened together (i.e., not evaluated separately) are considered equally suitable (at the screening level of evaluation). Selection of representative process options is performed during the development of alternatives, so that best engineering judgment may be used to select and combine appropriate technologies and process options into cohesive, integrated removal alternatives.

The potentially applicable technologies considered for the Site are presented in Table 7-1. The technology screening is also presented in this table. Retained technologies are assembled into alternatives in the next section.

8.0 ASSEMBLY AND SCREENING OF REMOVAL ALTERNATIVES

In order to meet the RAOs for the Site, the following removal alternatives have been assembled using the technologies retained in Section 7:

1. No Further Action
2. Institutional Controls
3. Focused improvements in Containment and LNAPL Recovery
4. Complete Replacement of the Existing Containment and LNAPL Recovery System
5. Complete Containment/Recovery Replacement and "Hot Spot" Treatment
6. Complete Containment/Recovery Replacement and Major Source Treatment
7. Treatment of the Entire LNAPL Plume Area
8. Excavation and Off-Site Disposal for the Entire LNAPL Plume Area

Common components are discussed in the next section, followed by summary descriptions of the alternatives.

8.1 Components of the Alternatives

Components used in more than one alternative are described in this section.

8.1.1 Institutional Controls

Institutional controls would reduce risk by reducing the potential for contact with or ingestion of Site contamination. Land use restrictions would help control site access, minimizing the potential for direct contact with contaminated soil and ensuring that full-time residential use of the Site does not occur. Groundwater use restrictions would prohibit drinking water wells at the Site, preventing contact with or ingestion of contaminated groundwater.

8.1.2 Improved Containment and LNAPL Recovery

A LNAPL containment and recovery system is in place at the Site, but has proven ineffective at keeping LNAPL from entering the river during low water periods. While we do not know with certainty, the apparent problem with this system is that the plastic liner used for containment has gaps (particularly at the bottom) through which LNAPL can move.

Two options for improved containment are considered:

- **Focused improvements in containment and LNAPL recovery –** A new, more reliable system would be installed along the river in the area where the current system has proven ineffective (i.e., where LNAPL has been observed entering the river). Further downstream, where LNAPL has not been observed entering the river, the existing system would remain and continue to be used. As a contingency, the new system could be extended in the future if the remaining existing system were to fail.

- **Complete replacement of the containment and LNAPL recovery system –** A new, more reliable system would be installed along the river for the entire length of the plume. None of the existing containment/recovery system would remain.

Improved containment would also include a minimum two-foot clean soil cover over areas where impacted soil would remain after containment system installation. Clean soils are defined as being acceptable for residential land use and represent acceptable concentrations for the protection of terrestrial wildlife.

Improved containment would protect human health and the environment as follows:

- Containment would prevent LNAPL from reaching the river.
- LNAPL collection and removal would provide treatment to slowly clean up the Site. At some future time there would be no more mobile LNAPL to collect, and therefore no further risk to the river.
- The soil cover would prevent direct contact with contaminated soil by human and ecological receptors.

8.1.3 Excavation and Soil Washing

Soil washing would consist of excavation to remove impacted soil, as well as excavation and separate stockpiling of clean soil overburden. Using the "observational approach", excavated soils would be tested in the field and segregated based on the need for treatment. A sheen test is anticipated to be a suitable field test.

Excavated soil meeting criteria for requiring treatment would then be treated. The treatment consists of a combination of size separation and water washing to remove hydrocarbons from the soil. The treatment process is further described in the Site-specific Treatability Study Report (Appendix F), as well as the effectiveness of this treatment.

Below the water table, the excavation would be backfilled with clean soil, while the remainder of the excavation would be backfilled with the treated soils meeting cleanup criteria. A 2-ft clean soil cover would be placed over the treated soils.

Soil washing would have residual filter cake (~5% of treated soil volume) requiring further treatment or off-site disposal. Further treatment could consist of on-site land treatment or thermal desorption.

8.1.4 Sediment Removal

Removal of river sediment is not included in any of the alternatives. As discussed in Section 5.3.3.2, sediment only slightly exceeds screening levels in the near shore from RS-3 to RS-5 river stations. It is not clear that it is necessary to remove sediment for protection of river ecology. On the other hand, removing the sediment could adversely affect the river (even with protective measures).

Dredging of river sediment would stir up fines in the sediment, thus mobilizing contaminants for migration. Dredging would employ protective measures, such as a silt fence or a cofferdam, but these measures could not guarantee retention of all of the mobilized sediments. Any sediment and oil containment system would have to extend into the river well beyond the excavation limits for the entire excavation period. In the case of a silt fence, such fences are not 100% effective; some contaminated sediment would inevitably escape to the river during dredging. Log debris in the river has the potential to disrupt a silt fence and cause releases to the river. In addition, a sudden rise in river level and current during a storm could rip the fence, allowing the river to wash out contaminated sediment produced by the dredging; this includes both suspended and fine sediment on the bed. In the case of a cofferdam, the dam would be more effective than a silt fence, but a rise in river level during a storm could overtop the dam and wash out fine contaminated sediment.

Dredging the sediment will remove the existing benthic invertebrate population and disturb the existing habitat. Thus, dredging has the potential to do more harm than good to the river ecology in the short term. Because the St. Joe River is critical habitat for bull trout, implementation of sediment removal may be difficult in light of requirements under the Endangered Species Act.

8.1.5 Natural Attenuation for Sediments

Instead of sediment removal, contamination in river sediments will be allowed to degrade by natural attenuation. A combination of microbial degradation and slow dissolution of the hydrocarbons will slowly remove contamination from the sediments. The high-molecular-weight hydrocarbons will degrade very slowly; these same hydrocarbons will tend to sorb to the sediments and not release to the river via dissolution.

8.2 Description of the Alternatives

8.2.1 No Further Action

In this alternative, the existing containment system would remain in place. Current LNAPL removal operations, maintenance, and monitoring would continue until LNAPL discharges stopped occurring for five years (assumed for cost estimating to be 50 years). No institutional controls would be provided. This alternative will serve as a baseline for comparison to the other alternatives.

8.2.2 Institutional Controls

This alternative includes the following components:

- Continued use of the current containment system
- Continued LNAPL removal using the current system
- Institutional controls as described in Section 8.1.1
- Natural attenuation of near-shore sediments
- Long-term maintenance and monitoring.

This alternative would continue current LNAPL collection and removal operations, maintenance, and monitoring, plus add institutional controls as discussed in Section 9.1.1. Institutional controls would reduce risk by reducing the potential for contact or ingestion exposure to Site contamination. Land use restrictions would help control site access, minimizing the potential for direct contact with contaminated soil and ensuring that full-time residential use of the Site does not occur. Groundwater use restrictions would prohibit drinking water wells at the Site, preventing contact with or ingestion of contaminated groundwater. Institutional controls would include a deed restriction to prohibit a river water intake on the Site (to prevent ingestion of or contact with contamination from the near-shore LNAPL recovery area). Maintaining the booms in the river to contain and collect LNAPL, combined with warning signs adjacent to the river in the area of RS-3 and RS-4, will minimize the potential for human contact with or ingestion of impacted surface water.

8.2.3 Focused Improvements in Containment and LNAPL Recovery

This alternative includes the following components:

- Institutional controls as described in Section 8.1.1
- Focused improvements in containment and LNAPL recovery, as discussed in Section 8.1.1
- Natural attenuation of near-shore sediments
- Long-term maintenance and monitoring

In this alternative, protection of human health and the environment would be provided primarily by containment. A concrete wall or barrier/collector trench with LNAPL recovery would prevent LNAPL from entering the river, and a clean soil cover would minimize direct contact. The improved LNAPL containment and recovery would be restricted to the length of the river where LNAPL has been observed entering the river at low water level periods. For the remainder of the LNAPL plume, the existing LNAPL containment and recovery system would continue to be used. Impacted river sediments would not be removed, but allowed to slowly naturally attenuate.

8.2.4 Complete Replacement of the Containment and LNAPL Recovery System

This alternative includes the following components:

- Institutional controls as described in Section 8.1.1
- Complete replacement of the containment and LNAPL recovery system, as discussed in Section 8.1.1
- Natural attenuation of near-shore sediment
- Long-term maintenance and monitoring

In this alternative, protection of human health and the environment would be provided primarily by containment. A concrete wall or barrier/collector trench with LNAPL recovery would prevent LNAPL from entering the river, and a clean soil cover would minimize direct contact. Unlike the previous alternative,

the improved LNAPL containment and recovery would completely replace the existing system along the entire length of the LNAPL plume. As proposed for the previous removal alternative, impacted river sediments would not be removed, but allowed to slowly naturally attenuate.

8.2.5 Complete Containment/Recovery Replacement and "Hot Spot" Treatment

This alternative includes the following components:

- Institutional controls as described in Section 8.1.1
- Complete replacement of the containment and LNAPL recovery system, as discussed in Section 8.1.2
- Treatment of "hot spots" in the source area
- Natural attenuation of near-shore sediments
- Long-term maintenance and monitoring

Like the previous alternative, this alternative would rely primarily on containment. However, treating selected areas with the highest contamination would remove some of the source and decrease the time required for completion of LNAPL removal. Determination of "hot spots" would be made during the removal action using the "observational approach" by means of exploratory trenches. Treatment would consist of soil washing, as described in Section 8.1.3. Impacted river sediments would not be removed, but allowed to slowly naturally attenuate.

8.2.6 Complete Containment/Recovery Replacement and Major Source Treatment

This alternative includes the following components:

- Institutional controls as described in Section 8.1.1
- Complete replacement of the containment and LNAPL recovery system, as discussed in Section 8.1.2
- Treatment of soils in the major source area
- Natural attenuation of near-shore sediments
- Long-term maintenance and monitoring

Major source treatment would remove the bulk of Site contamination above cleanup levels, substantially decreasing the time for Site cleanup to be achieved, except contamination in river sediments will degrade slowly by natural attenuation. The major source area is considered to be that part of the Site with vadose zone contamination from approximately 5-foot-depth to the water table. Treatment would consist of soil washing, as described in Section 8.1.3.

8.2.7 Treatment of the Entire LNAPL Plume Area

This alternative includes the following components:

- Treatment of all soil above removal criteria
- Natural attenuation of near-shore sediments

In this alternative, the entire area of the LNAPL plume would be treated. Treatment would consist of soil washing, as described in Section 8.1.3.

Institutional controls would not be required in this alternative because, upon completion of the removal action, RAOs would be achieved, except impacted sediments will degrade slowly by natural attenuation. There would be no need for long-term maintenance and monitoring.

8.2.8 Excavation and Off-Site Disposal for the Entire LNAPL Plume Area

This alternative includes the following components:

- Excavation and off-site disposal of all soil above removal criteria
- Natural attenuation of near-shore sediments

In this alternative, the entire area of the LNAPL plume would be excavated. This alternative would involve excavating a large quantity of clean overburden (i.e., to reach contaminated smear zone soils outside of the major source area). The excavation would be backfilled using the clean overburden and imported clean soil.

All contaminated soil above the removal criteria would be disposed off-site in a permitted landfill.

Institutional controls would not be required in this alternative because, upon completion of the removal action, RAOs would be achieved, except impacted sediments will degrade slowly by natural attenuation. There would be no need for long-term maintenance and monitoring.

8.3 Screening of Removal Alternatives

Alternative 7 (Excavation and Off-Site Disposal for the Entire LNAPL Plume Area) is rejected for further evaluation because:

- Off-site disposal of the estimated 106,000 tons of contaminated soil would result in a large increase in truck traffic with potential adverse effects.
- A very large quantity of clean soil would need to be imported to the Site. This quantity would be difficult to obtain, and also increase truck traffic in addition to the traffic for hauling off contaminated soil.
- The unit cost for excavation, off-site disposal, and clean soil backfill would be on the order of $80/ton, which significantly exceed the estimated unit costs for on-site treatment.
- Unlike on-site treatment options, off-site disposal would simply relocate the contaminated soil. RAOs can be achieved more cost-effectively, with fewer short-term adverse effects, by the other alternatives.

The remaining alternatives are retained for further development and evaluation.

9.0 DESCRIPTIONS OF THE ALTERNATIVES

This section describes the removal alternatives in sufficient detail for evaluation. The alternatives retained after screening (renumbered A – G for clarity) are:

Alternative A – No Further Action
Alternative B – Institutional Controls
Alternative C-1 – Focused Improvements in Containment and LNAPL Recovery Using a River Wall
Alternative C-2 – Focused Improvements in Containment and LNAPL Recovery Using a Trench
Alternative D – Complete Replacement of the Containment and LNAPL Recovery System
Alternative E – Complete Containment/Recovery Replacement and "Hot Spot" Treatment
Alternative F – Complete Containment/Recovery Replacement and Major Source Treatment
Alternative G – Treatment of the Entire LNAPL Plume Area

It is necessary to make a number of design assumptions to fully develop and evaluate each alternative. These design assumptions are representative of the technologies used in the alternatives. However, the design assumptions used here are not necessarily the same as the design basis that would be used for the final, detailed design. Additional investigations may be necessary to provide information needed for final design.

9.1 Components of the Alternatives

Components used in more than one alternative are described in this section.

9.1.1 Institutional Controls

Institutional controls would reduce risk by reducing the potential for contact with or ingestion of Site contamination. Land use restrictions would help control site access, minimizing the potential for direct contact with contaminated soil and ensuring that full-time residential use of the Site does not occur. Groundwater use restrictions would prohibit drinking water wells at the Site, preventing contact with or ingestion of contaminated groundwater. For Alternatives B, institutional controls would include a deed restriction to prohibit on a river water intake on the Site (to prevent ingestion of or contact with contamination from the near-shore LNAPL recovery area) and warning signs at the Site along the river to prevent recreational contact with contamination in this area.

9.1.2 Natural Attenuation of Near-Shore River Sediments

Because impacted river sediments that have the potential to have adverse effects on existing benthic invertebrate population are limited in extent, sediment removal has the potential to do more harm than good to the river ecology in the short term. The north near-shore sediments are impacted upstream of the Site with the same COCs from other anthropogenic sources. The north near-shore sediments are, therefore, not pristine and have the potential to re-contaminate downstream sediments in the future. A failure of a river-based oil and sediment capture and control system has the potential for a large sudden

release. For these reasons, sediment removal has not been included in any of the alternatives and this RAO regarding impacted river sediments will be remediated by natural attenuation.

9.1.3 Monitoring

Monitoring is included as part of all alternatives, including the "No Further Action" alternative. Separate monitoring programs will be used for the short term (during removal action) and the long term (following completion of removal action). Detailed monitoring plans will be developed for the selected remedy during final design.

Short-term monitoring is conducted during removal to 1) ensure that there are no adverse effects from exposures to construction workers or to the environment and 2) provide quality control during removal activities.

Long-term monitoring is conducted to 1) to evaluate the performance of the remedy and 2) to allow timely maintenance of permanent physical components of an alternative.

9.1.4 Long-Term Operation and Maintenance

For alternatives where contamination above removal levels remains after the removal action, the following maintenance activities are assumed:

- LNAPL removal as long as LNAPL remains on the groundwater
- Inspection and maintenance of LANPL extraction system
- Inspection and maintenance of groundwater monitoring wells
- Inspection and maintenance of the soil cover

The length of time required for these activities is indeterminate, and varies with the alternative.

9.1.5 General Site Support Activities

General Site support activities are similar for all of the alternatives and would consist of the following:

- Providing temporary facilities such as field offices, change rooms, electrical generators, sanitary facilities, and the like.
- Mobilizing and demobilizing equipment for earthworks activities such as excavators, trucks, loaders, and compactors.
- Implementing erosion and sediment control measures, including a cofferdam to protect the river from turbid water from construction in and along the river.
- Establishing site security with chain link fencing and gates.
- Disconnecting and terminating the existing electrical service on the Site where it crosses the St. Joe River.
- Reseeding disturbed areas.
- Removing temporary facilities and cleaning up the Site at the end of the removal action.

9.1.6 Soil Cover for Containment Alternatives

Improved containment would include a clean soil cover over any areas where contaminated soil remains after completion of removal actions. This soil cover would be at least 2 feet thick. Clean soils are defined as being acceptable for residential land use and represent acceptable concentrations for the protection of terrestrial wildlife. Clean soil removed during excavation would be stockpiled for reuse in constructing the soil cover and for backfilling excavated areas.

9.1.7 Improved LNAPL Containment and Recovery

The objective of improved LNAPL containment and recovery would be to construct a system to prevent LNAPL from entering the St. Joe River that is more effective and reliable than the existing system. Two options for improvements in LNAPL containment and recovery are considered:

- A concrete retaining wall constructed along the shore
- An LNAPL interception/recovery trench with a downgradient barrier ("barrier/collection trench")

9.1.7.1 Concrete River Wall

A concrete river wall for LNAPL interception and recovery would consist of two main parts: a below-grade containment wall, and an above-grade reinforced concrete wall on top of the containment wall. A plan view and cross-section of this system is shown on Figure 9-1.

The initial activity would consist of removing the existing riprap from the shoreline. Some of this riprap would be placed at the upstream and downstream ends of walls to provide enhanced erosion protection in these areas. Any contaminated riprap would be cleaned (e.g., by pressure washing) prior to replacement.

After the riprap has been removed, a layer of appropriately sized small armor rock, gravel, or other material would be placed on the slope face to stabilize the face against erosion. The centerline of the walls would be located at the toe of the armor rock slope. This location would be a few feet back from the present shoreline (i.e., the toe of the existing riprap).

To prevent construction equipment from working directly in the river and generating large quantities of sediment and suspended solids, a clean soil pad about 20 feet wide would be constructed along the toe of the armor rock slope. The below-grade portion of the containment wall would be constructed by overlapping auger-cast piles, where cement is injected and mixed into the soil in situ to form the pile. For purposes of this EE/CA, the piles are assumed to be 18 inches in diameter and spaced on 1-foot centers. They would be constructed to a depth of 5 to 6 feet below the low-water level of the river, which would put the base of the pile below the bottom of the river bed. The auger-cast pile wall would provide a low-permeability barrier and a suitable foundation for the above-grade portion of the wall.

A reinforced concrete wall (cast-in-place or prefabricated in sections, if available) would be constructed above the auger-cast containment wall. The purpose of the above-grade wall would be to isolate the

product collection area behind the wall from the St. Joe River. To accomplish this, the wall would need to be high enough so that it is not overtopped by the river during the design high-water event. If the concrete containment wall were implemented, this height would need to be determined during detailed design. For estimating purposes, it has been assumed at 10 feet above the low-water river level.

For estimating purposes, the conceptual design of this wall includes counterforts to resist the loads from river current and high river levels. To resist overturning during these conditions, the base slab would be connected at each counterfort to a reinforced auger-cast anchor pile.

The containment wall would create a LNAPL collection channel between the wall and the shoreline. The LNAPL would collect on the surface of the water in this channel and would be periodically removed and treated or disposed.

Positive containment at the downstream end of the wall would be ensured by constructing a cast-in-place concrete cutoff wall extending back into the shoreline for a total distance of about 30 feet. The base of this cutoff wall would be at the same elevation as the base of the auger-cast containment wall. For alternatives where the containment wall does not extend the full length of the LNAPL plume, the wall would tie into the existing geomembrane barrier.

9.1.7.2 Barrier/Collection Trench

A barrier/collection trench would be a gravel-filled trench with an impermeable downgradient barrier for LNAPL interception and recovery. Vertical risers in the trench would allow access to accumulated LNAPL for removal. The layout of this trench is shown on Figure 9-2; cross-sections showing construction and final appearance are shown in Figures 9-3 and 9-4.

The impermeable downgradient barrier would be placed against the wall of the trench nearest the river, and would be constructed of steel, high-density polyethylene (HDPE), or other impermeable material. The trench and barrier would extend in depth to an elevation about 2 feet below the bottom of the river bed, assumed to be 5 or 6 feet below the seasonal low water level. With these assumptions, the total depth of the trench would be 15 feet.

The shoreline along the barrier/collection trench alignment would be excavated during construction. Disposition of the removed materials would be as follows:

Clean Riprap: Based on field observations, it is assumed that the upper 12 vertical feet of the existing riprap is free of contamination. This clean riprap would be hauled to an onsite area west of the contamination plume and stockpiled for later reuse.

Contaminated Riprap: The lower 3 vertical feet of the existing riprap is assumed to be contaminated. This material would be hauled to a geomembrane-lined treatment area and steam cleaned and/or pressure washed to remove the contamination. It would then be stockpiled with the clean riprap for later reuse.

Foundations: Based on historical records, it is possible that reinforced concrete foundations from former railroad structures would be encountered during soil removal. These foundations would be broken into manageable-size pieces. The reinforcing steel would be removed and salvaged where practical. The larger concrete fragments would be cleaned, if necessary, and stockpiled with the riprap for future use. Smaller fragments would be used as backfill, if clean, or would be handled as contaminated soil.

Geosynthetics and Wood: Geomembrane and geotextile from previous remediation activities would be removed and disposed of in a permitted offsite facility. Similarly, the wood dock and other materials that cannot be cleaned or easily disposed of on the Site would be sent to an off-site disposal facility. For purposes of this EE/CA, it is assumed that the nearest suitable disposal facility is the Missoula Landfill operated by Republic Industries, at a road distance of about 150 miles from the Site.

Clean Soils: Based on field investigation results, it is assumed that the upper 3 feet of soil within the removal area is clean. This soil would be stockpiled on the Site for later use as backfill. Any near-surface soils that appear impacted will be stockpiled with other impacted soils (either for vadose zone backfill or for treatment) depending on the level of contamination.

Contamination in "Major Source Area": Based on field investigation results, it is assumed that the contaminated soil zone in the major source area (see Figure 9-9) extends from 3 feet to 11 feet below the ground surface (bgs).

Contamination in the "Smear Zone": It is assumed that the soils from 4 feet above to 2 feet below the seasonal low groundwater table (i.e., 11 to 17 feet bgs) are contaminated throughout the area of the LNAPL plume (including the "major source area").

Soils with Contamination Below Cleanup Levels (BCL): For alternatives that include treatment, excavated soil will be tested in the field to determine whether it requires treatment. Contaminated soil not meeting criteria to be treated would be stockpiled on site for later use as backfill. For purposes of this EE/CA, it is assumed that only soils exhibiting an oil sheen when placed in water ("sheen test") will require treatment, and the remainder will be "BCL soil" not requiring treatment. It is assumed that 50% of the soil in the major source area is BCL, and that 0% of the contaminated soil in the "smear zone" is BCL.

The area adjacent to the shoreline where soil has been removed would be partially backfilled with clean soil to form a bench for installing the barrier/collector trench. The source of backfill soil would be clean soil and soils with contamination less than cleanup levels removed during the previous excavation of this area. The elevation of the upper surface of the backfill would be above the design-basis high water stage of the St. Joe River. This elevation would be determined during the detailed design process, but for purposes of this EE/CA, is assumed to be 10 feet above the seasonal low water level.

The slope of the new shoreline along the river would be protected from erosion by replacing the 5-foot-thick riprap layer (see Figure 9-4). Clean riprap, washed riprap, and foundation fragments would be used for this purpose. Because the replacement slope is flatter than the original removal slope, and because the extent of riprap protection along the river has been increased to the full length of the trench, the available volume of material from on-site sources is insufficient for this purpose. Additional material from off-site would be imported as necessary.

9.1.8 Excavation and Soil Washing

Soil washing is an ex-situ treatment process that combines size separation (screening) and water washing to remove hydrocarbons from the soil.

Using the “observational approach”, excavated soils would be tested in the field and segregated based on the need for treatment. A sheen test is anticipated to be a suitable field test. Excavated soil meeting criteria for requiring treatment would then be treated. In addition, as buried trash and debris are encountered; this material would be segregated from the soil and disposed at an off-site permitted trash landfill.

Excavation would extend to approximately 2 feet below the seasonal low groundwater level. Dewatering of the excavation would be not be feasible, because it would be necessary to have a cutoff wall around the excavation (the permeable soils hydraulically connected to the river make it impractical to dewater without a cutoff wall). A cutoff wall would need to key into bedrock. The depth to bedrock has not been determined, but it is estimated that the wall would need to extend approximately 20 feet below the groundwater level. Driving sheet piling in coarse gravels with large boulders would not work; a slurry wall would be used instead. Such a wall would cost well in excess of $1 million (for “major source removal”). Instead of dewatering, excavation below the water table would be performed “in the wet” during periods of low water levels (i.e., summer and fall). Floating oil (LNAPL) on water in the excavation would be collected and removed. Oil booms would be used as needed to keep LNAPL from contaminating clean backfill.

A process flow diagram for soil washing is shown in Figure 9-5. The treatment process is further described in the Treatability Study Report (Appendix F). The treatment effectiveness, based on the Site-specific treatability study, is presented in this report.

Based on the treatability study results, it is anticipated that water with surfactant would be used. Based on the results for the unsaturated soil sample tested (TS-4U), it may be necessary to add a flotation process to the treatment sequence to improve its effectiveness. If soil washing is included in the selected alternative, an additional pre-design study may be necessary to optimize the treatment process.

During soil treatment, no wastewater would be discharged from the treatment system, because all of the washwater would be recycled. Upon completion of soil washing, a small quantity of residual washwater would be treated and discharged by spreading on the treated soils before these soils are covered by the clean soil cover.

Based on the treatability study results and additional sheen testing of the residuals, it is estimated that approximately 95% of the treated soil (gravel and sand) would meet cleanup criteria. The excavation would be backfilled with the treated soils meeting cleanup criteria, except that clean soil would be used to backfill below the water table. Additionally, a clean soil cover (see Section 9.1.5) would be placed over the treated soils.

Soil washing would have residual filter cake (~5% of treated soil volume) that could require further treatment or off-Site disposal. Further treatment could consist of on-Site land treatment or thermal desorption.

For purposes of this EE/CA, the following assumptions have been made for soil washing:

- The same size treatment unit would be used in all soil washing alternatives, with a nominal production rate of 50 tons/hour.
- Plant availability would be 85%.
- Operations would be two 10 hour shifts per day, 5 days per week.
- There would be 5 operators per shift (3 in the plant and 2 in dewatering and clarification).
- Filter cake would be disposed off-site.

The processing difference between the soil washing alternatives would be the time required to complete treatment, which depends on the quantity of soil requiring treatment.

9.2 Development of the Alternatives

9.2.1 Alternative A – No Further Action

In this alternative, the current containment system would remain. Current LNAPL removal operations, maintenance, and monitoring would continue. The current soil cover prevents direct contact of human and ecological receptors with contaminated soil. No institutional controls would be provided. This alternative serves as a baseline for comparison to the other alternatives.

9.2.2 Alternative B – Institutional Controls

This alternative includes the following components:

- Continued use of the current containment system
- Continued LNPAL removal using the current system
- Institutional controls as described in Section 9.1.1
- Natural attenuation of near-shore sediments
- Long-term maintenance and monitoring

As with the “No Further Action” alternative, current LNAPL removal operations, maintenance, and monitoring would continue. This alternative would continue current LNAPL collection and removal operations, maintenance, and monitoring, plus add institutional controls as discussed in Section 9.1.1. Institutional controls would reduce risk by reducing the potential for contact or ingestion exposure to Site contamination. Land use restrictions would help control site access, minimizing the potential for direct contact with contaminated soil and ensuring that full-time residential use of the Site does not occur. Groundwater use restrictions would prohibit drinking water wells at the Site, preventing contact with or ingestion of contaminated groundwater. Institutional controls would include a deed restriction to prohibit a river water intake on the Site (to prevent ingestion of or contact with contamination from the near-shore

LNAPL recovery area). Maintaining the booms in the river to contain and collect LNAPL, combined with warning signs adjacent to the river in the area of RS-3 and RS-4, will minimize the potential for human contact with or ingestion of impacted surface water.

9.2.3 Alternative C-1 – Focused Improvements in Containment and LNAPL Recovery Using a River Wall

This alternative includes the following components:

- Institutional controls as described in Section 9.1.1
- Clean soil cover (see Section 9.1.5)
- Focused improvements in containment and LNAPL recovery using a concrete river wall (see Section 9.1.6.1)
- Natural attenuation of near-shore sediments
- Long-term maintenance and monitoring

In this alternative, protection of human health and the environment would be provided primarily by containment – a concrete river wall with LNAPL recovery to keep LNAPL from the river, and a soil cover to minimize direct contact. The improved LNAPL containment and recovery would be restricted to the length of the river where LNAPL has been observed entering the river (see Figure 9-3). For the remainder of the LNAPL plume, the existing LNAPL containment and recovery system would continue to be used. The difference between Alternative C-1 and Alternative C-2 is that Alternative C-1 uses a concrete river wall, whereas Alternative C-2 uses a barrier/collector trench.

9.2.4 Alternative C-2 – Focused improvements in Containment and LNAPL Recovery Using a Trench

This alternative includes the following components:

- Institutional controls as described in Section 9.1.1
- Clean soil cover (see Section 9.1.5)
- Focused improvements in containment and LNAPL recovery using a barrier/collection trench (see Section 9.1.6.2)
- Natural attenuation of near-shore sediments
- Long-term maintenance and monitoring

In this alternative, protection of human health and the environment would be provided primarily by containment. A barrier/collection trench would be a gravel-filled trench with an impermeable downgradient barrier with LNAPL recovery to keep LNAPL from the river, and a soil cover to minimize direct contact. The improved LNAPL containment and recovery would be restricted to the length of the river where LNAPL has been observed entering the river (see Figure 9-3). For the remainder of the LNAPL plume, the existing LNAPL containment and recovery system would continue to be used.

9.2.5 Alternative D – Complete Replacement of the Containment and LNAPL Recovery System

This alternative includes the following components:

- Institutional controls as described in Section 9.1.1
- Clean soil cover (see Section 9.1.5)
- Complete replacement of the containment and LNAPL recovery system using a barrier/collector trench, as discussed in Section 9.1.6.2
- Natural attenuation of near-shore sediments
- Long-term maintenance and monitoring

In this alternative, protection of human health and the environment would be provided primarily by containment: a barrier/collector trench with LNAPL recovery to keep LNAPL from the river, and a soil cover to minimize direct contact. Unlike the previous alternative, the improved LNAPL containment and recovery would completely replace the existing system along the entire length of the LNAPL plume.

9.2.6 Alternative E – Complete Containment/Recovery Replacement and "Hot Spot" Treatment

This alternative includes the following components:

- Institutional controls as described in Section 9.1.1
- Clean soil cover (see Section 9.1.5)
- Complete replacement of the containment and LNAPL recovery system using a barrier/collector trench, as discussed in Section 9.1.6.2
- Treatment of "hot spots" in the source area
- Natural attenuation of near-shore sediments
- Long-term maintenance and monitoring

Like Alternative D, this alternative would rely primarily on improved containment and LNAPL recovery. However, treatment would be provided for "hot spots", which are defined as localized areas where contaminant levels are significantly higher than elsewhere (see Figures 9-6, 9-7. and 9-8). The purpose of hot spot treatment would be to remove some of the source and decrease the time required to complete NAPL removal.

Treatment in this alternative would be the soil washing process, as described in Section 9.1.7. In this alternative, contaminated soil for treatment would be generated both from excavation of "hot spots" – localized areas where contaminant levels are significantly higher than elsewhere – and also from excavation adjacent to the shoreline. If this alternative were implemented, the actual extent of hot-spots would be determined in the field as excavation proceeded ("observational approach"), using visual observations and field testing. Soil requiring treatment (i.e., above removal criteria) would be segregated from soil not requiring treatment (i.e., below removal criteria). A sheen test is anticipated to be a suitable field test.

For purposes of this EE/CA, it is assumed that:

- The upper 3 feet of the hot spots areas consists of clean soil which would be removed and stockpiled.
- Side slopes for hot-spot excavations would be laid back at 1.5H:1V for stability.
- Soil in the removal area would be excavated down to 2 feet below the seasonal low groundwater table (17 feet bgs) within the hot-spot footprint.
- A portion of the western hot-spot would not be completely excavated, to avoid disturbing or undermining the Highway 50 Road.
- For the barrier/collector trench, 50% of the soils would be treated.
- For the "hot spots", all of the excavated soils would be treated

After soil washing has been completed, the hot-spot excavations would be backfilled and reseeded. Where the product of soil washing has residual oil (below the cleanup criteria), this soil would be placed under the clean soil cover, but above the water table.

9.2.7 Alternative F – Complete Containment/Recovery Replacement and Major Source Treatment

This alternative includes the following components:

- Institutional controls as described in Section 9.1.1
- Clean soil cover (see Section 9.1.5)
- Complete replacement of the containment and LNAPL recovery system using a barrier/collector trench, as discussed in Section 9.1.6.2
- Treatment of soils in the major source area
- Natural attenuation of near-shore sediments
- Long-term maintenance and monitoring

In this alternative, treatment of the major source area would remove the bulk of Site contamination above cleanup levels, greatly decreasing the time for Site cleanup to be achieved. The major source area is considered to be part of the Site with vadose zone contamination from approximately 5-foot-depth to the water table (see Figures 9-9, 9-10, and 9-11). The alternative also includes improved containment as described Sections 9.1.5 and 9.1.6.2.

Treatment in this alternative would be the soil washing process, as described in Section 9.1.7. If this alternative were implemented, the major source area would be excavated, with the boundaries of the excavation determined in the field as excavation proceeded ("observational approach"), using visual observations and field testing. Soil requiring treatment (i.e., above removal criteria) would be segregated from soil not requiring treatment (i.e., below removal criteria). A sheen test is anticipated to be a suitable field test.

For purposes of this EE/CA, it is assumed that:

- The upper 3 feet of the major source area consists of clean soil which would be removed and stockpiled.
- Side slopes for excavations would be laid back at 1.5H:1V for stability.
- Soil in the removal area would be excavated down to 2 feet below the seasonal low groundwater table (17 feet bgs) within the major source area footprint.
- The northern part of the major source area would not be completely excavated, to avoid disturbing the St. Joe River Road.
- 50% of the soil from 3 feet bgs to 11 feet bgs is contaminated and would require treatment; the remainder of the soil from this zone would be stockpiled.
- All of the soil from 11 feet bgs to the maximum excavation depth would require treatment.

As treatment progresses, the excavation would be backfilled to the original grade and reseeded. Where the product of soil washing has residual oil (below the cleanup criteria), this soil would be placed under the clean soil cover, but above the water table.

9.2.8 Alternative G – Treatment of the Entire LNAPL Plume Area

This alternative includes the following components:

- Treatment of all soil within the plume area above removal criteria
- Natural attenuation of near-shore sediments

In this alternative, the entire area of the LNAPL plume would be excavated and treated, as shown in Figures 9-12, 9-13, and 9-14. No LNAPL containment wall or barrier/collection trench is included in this alternative.

Institutional controls would not be required in this alternative because, upon completion of the removal action, RAOs would be achieved.

Because no contamination above cleanup criteria would remain on the Site after completion of this alternative, it has been assumed that no long-term maintenance and monitoring would be required.

Treatment in this alternative would be the soil washing process, as described in Section 9.1.7. If this alternative were implemented, the entire area of the LNAPL plume would be excavated (see Figure 9-15), with the boundaries of the excavation determined in the field as excavation proceeded (“observational approach”), using visual observations and field testing. Soil requiring treatment (i.e., above removal criteria) would be segregated from soil not requiring treatment (i.e., below removal criteria). A sheen test is anticipated to be a suitable field test.

For purposes of this EE/CA, it is assumed that:

- The St. Joe River Road would be temporarily re-routed through the Site to allow removal of contaminated soil under the current road location.
- The portion of the St. Joe River Road that was destroyed to allow removal activities would be reconstructed in its original location at the end of the project.
- The existing riprap shoreline protection, foundations, geosynthetics, and wood would be removed and managed in the same way as for the containment alternatives.
- The upper 3 feet of the removal area consists of clean soil which would be excavated and stockpiled.
- Side slopes for excavations would be laid back at 1.5H:1V for stability.
- Soil in the removal are would be excavated down to 2 feet below the seasonal low groundwater table (17 feet bgs) within the NAPL plume area.
- 50% of the soil from 3 feet bgs to 11 feet bgs is contaminated and would require treatment; the remainder of the soil from this zone would be stockpiled.
- All of the soil from 11 feet bgs to the maximum excavation depth would require treatment.
- Shoreline protection would be reconstructed as for the containment alternatives, except that it would extend to a higher elevation because the backfill would be placed to the existing elevation of 15 feet above the seasonal low groundwater table.

As treatment progresses, the excavation would be backfilled to the original grade and reseeded. Where the product of soil washing has residual oil (below the cleanup criteria), this soil would be placed under the clean soil cover, but above the water table.

10.0 DETAILED EVALUATION OF ALTERNATIVES

The retained alternatives are evaluated in this section, using the criteria specified for an EE/CA evaluation under CERCLA (EPA, 1993): effectiveness, implementability, and cost. A preferred alternative is recommended based on this evaluation.

10.1 Effectiveness

The effectiveness criterion addresses how well the alternatives protect human health and the environment, considering short-term as well as long-term effects, and the reliability of the alternative in achieving the expected effectiveness. For this evaluation, overall effectiveness has been evaluated using the following sub-criteria:

- **Long-Term Effectiveness –** how well the alternative is expected to protect human health and the environment after completion of remedial action.
- **Reliability –** The confidence in the alternative achieving the expected effectiveness under site conditions. Uncertainties in site conditions and the extent to which the component technologies are proven (established) are reliability considerations.
- **Short-Term Effectiveness –** The effects of the alternative on human health and the environment during implementation, including potential risks to site workers, the community, and the environment.
- **Time –** the time required for completion of the alternative, including operations and maintenance.

10.1.1 Long-Term Effectiveness

The primary measure of long-term effectiveness is the extent to which RAOs are met. As specified in Section 6, the RAOs for this site are:

- Reduce exposure of potential future full-time residents to contaminated near-surface soils via direct contact and ingestion pathways.
- Reduce exposure of potential future full-time residents to direct contact and ingestion of groundwater and near-shore surface water impacted by LNAPL
- Protect surface water from LNAPL releases and thereby reduce direct contact and ingestion exposure of humans and aquatic organisms to LNAPL on surface water.
- Reduce ecological exposure to impacted sediments in the St. Joe River.

With respect to the first RAO (prevention of direct contact), Alternative G would leave no on-site soils with contamination above acceptable levels, so it is considered to have the greatest long-term effectiveness (although this consideration overlaps with reliability, because a soil cover is equally effective provided it is not breached). The Site has existing soil cover, so that direct contact of human or ecological receptors to contaminated soil is already reduced to some extent even in Alternatives A and B. A more effective soil cover is provided in the remaining alternatives (C1, C2, D, and E).

With respect to the second RAO (prevention of exposure to contaminated groundwater), institutional controls to prevent use of on-site groundwater are included in all alternatives except Alternative A.

Alternative G does not include institutional controls, but removes contamination to remove the potential for exposure. While Alternative G does not explicitly include groundwater treatment, it includes excavation and treatment of soil in groundwater, which will result in incidental cleanup of groundwater. As with Alternative G, while Alternative F does not explicitly include groundwater treatment, significant groundwater would be treated incidental to major source removal, although to a lesser extent than Alternative G. The "hot spot" treatment in Alternative E would not provide significant incidental groundwater treatment.

With respect to the third RAO (protection of surface water from LNAPL), all of the alternatives will prevent release of LNAPL to the river. A new barrier and collection system along the entire length of the plume (Alternatives D, E, and F) is expected to be more effective than focused improvements (Alternative C1 and C2) in this regard. Alternatives A and B collect LNAPL at the edge of the river, which prevents LNAPL escape into the river channel, but is less effective than the other alternatives.

With respect to the fourth RAO (reduce sediment ecological risk), sediment removal is not included in any alternative for the reasons presented in Section 8.1.4. Potential sediment risks are discussed in Section 5.

On this basis, the alternatives are ranked as follows for long-term effectiveness (most to least effective):

1. Alternative G – Treatment of the Entire LNAPL Plume Area
2. Alternative F – Complete Containment/Recovery Replacement and Major Source Treatment
3. Alternative E – Complete Containment/Recovery Replacement and "Hot Spot" Treatment
4. Alternative D – Complete Replacement of the Containment and LNAPL Recovery System
5. (tie) Alternative C-1 – Focused Improvements in Containment and LNAPL Recovery Using a River Wall; Alternative C-2 – Focused Improvements in Containment and LNAPL Recovery Using a Trench
6. Alternative B – Institutional Controls
7. Alternative A – No Further Action

10.1.2 Reliability

Reliability in preventing exposure to contaminated soil and groundwater contamination, and release of LNAPL to the river, is increased to the extent that contamination is removed from the Site via soil treatment. Some groundwater treatment would be provided incidental to the soil treatment. Therefore, the scoring of the alternatives increases based on the extent of contaminant removal through treatment.

The proposed improved LNAPL barrier/collection system would be more reliable than the existing LNAPL containment system because:

- The bottom of the barrier will be significantly below the lowest river water level, making it impossible for LNAPL to go under the barrier (i.e., floating oil will not go below the water level). This is not true for the existing geomembrane barrier.
- The new system will be installed with strict quality control to ensure that the constructed system meets design specifications. Anecdotal information indicates that the geomembrane barrier was not installed to the design depth in all cases, and may not have been handled with sufficient care to avoid minor tears and punctures.
- The impermeable barrier will be immediately downgradient of the interception trench. In the existing system, the interception trench is several feet upgradient of the geomembrane barrier. It appears that the existing trench is not efficient in collecting LNAPL because the gravel in the trench is no less permeable than surrounding gravelly soils, so that the LNAPL passes through the trench and builds up behind the barrier beyond the collection system.

In addition, the existing LNAPL containment system does not extend the full length of the LNAPL plume. Therefore, Alternatives C1 and C2, where the new barrier/collection system does extend the full length of the LNAPL plume, are less reliable than alternatives where the new barrier/collection system extends the full plume length (Alternatives D, E, and F). All of these alternatives will be more reliable than Alternatives A and B, which rely on the existing LNAPL interception. Alternative G does not require LNAPL interception because all Site LNAPL would be removed by treatment.

The existing soil cover was not placed with the quality control (e.g., varying and uncertain thickness to contamination) that would be used for a new soil cover, so it is considered less reliable than a new soil cover (even though the new soil cover would not necessarily be thicker than the existing soil cover). Therefore, Alternatives A and B are less reliable than alternatives with a new soil cover (Alternatives C1, C2, D, E, and F) or that remove all contamination above acceptable levels (Alternative G).

Institutional controls provide measures to prevent exposure to site contamination (soil and groundwater), so Alternative B is more reliable than Alternative A.

On this basis, the alternatives are ranked as follows for reliability (most to least reliable):

1. Alternative G – Treatment of the Entire LNAPL Plume Area
2. Alternative F – Complete Containment/Recovery Replacement and Major Source Treatment
3. Alternative E – Complete Containment/Recovery Replacement and “Hot Spot” Treatment
4. Alternative D – Complete Replacement of the Containment and LNAPL Recovery System
5. (tie) Alternative C-1 – Focused Improvements in Containment and LNAPL Recovery Using a River Wall; Alternative C-2 – Focused Improvements in Containment and LNAPL Recovery Using a Trench
6. Alternative B – Institutional Controls
7. Alternative A – No Further Action

10.1.3 Short-Term Effectiveness

The potential for adverse effects to site workers increases with the amount of construction required and the complexity of the alternative. The potential for adverse effects to the community (public) also increase with the amount of construction required and the time required to complete construction, in this case mainly due to increased traffic. On the basis of potential risk to both workers and the community, Alternative G has the greatest potential risk due to extensive excavation and treatment and longer construction time, followed in order by Alternative F, then Alternative E, then Alternative D, then Alternatives C1 and C2. Alternatives A and B require no site construction, and therefore would not have associated worker risk.

Ecological risk during construction is primarily a function of the extent of work along the river. Although strict best management practices (BMPs) would be employed to protect the river during construction, there is potential for some release of contaminants that increases in relationship to the extent of work along the river required to implement the alternative. Alternative G has the most extensive work along the river, followed by the alternatives with a new containment barrier for the entire length of the LNAPL plume (Alternatives D, E, and F), followed by Alternatives C1 and C2 with a new containment barrier along a smaller length of the river. Alternatives A and B would not require work in or adjacent to the river.

On this basis, the alternatives are ranked as follows for short-term effectiveness (most to least effective):

1. Alternative A – No Further Action
2. Alternative B – Institutional Controls
3. (tie) Alternative C-1 – Focused Improvements in Containment and LNAPL Recovery Using a River Wall; Alternative C-2 – Focused Improvements in Containment and LNAPL Recovery Using a Trench
4. Alternative D – Complete Replacement of the Containment and LNAPL Recovery System
5. Alternative E – Complete Containment/Recovery Replacement and “Hot Spot” Treatment
6. Alternative F – Complete Containment/Recovery Replacement and Major Source Treatment
7. Alternative G – Treatment of the Entire LNAPL Plume Area

10.1.4 Time

The time sub-criterion has been ranked based on the estimated length of time required for operations and maintenance following completion of remedial action. This is the estimated time required for recovery of all mobile LNAPL in the Site soils, after which it is assumed that no LNAPL will remain capable of discharging to the river. The only factor differing between the alternatives that would affect the LNAPL discharge time is the degree of treatment provided.

On this basis, the alternatives are ranked as follows for the time sub-criteria (shortest to longest time):

1. Alternative G – Treatment of the Entire LNAPL Plume Area
2. Alternative F – Complete Containment/Recovery Replacement and Major Source Treatment
3. Alternative E – Complete Containment/Recovery Replacement and "Hot Spot" Treatment
4. (tie) Alternatives with no treatment: A, B, C1, C2, and D

10.1.5 Overall Effectiveness

Combining the sub-criteria evaluations, the alternatives are ranked as follows for overall effectiveness (most to least effective):

1. Alternative G – Treatment of the Entire LNAPL Plume Area
2. Alternative F – Complete Containment/Recovery Replacement and Major Source Treatment
3. Alternative E – Complete Containment/Recovery Replacement and "Hot Spot" Treatment
4. Alternative D – Complete Replacement of the Containment and LNAPL Recovery System
5. (tie) Alternative C-1 – Focused Improvements in Containment and LNAPL Recovery Using a River Wall; Alternative C-2 – Focused Improvements in Containment and LNAPL Recovery Using a Trench
6. Alternative B – Institutional Controls
7. Alternative A – No Further Action

10.2 Implementability

The implementability criterion addresses the degree of difficulty in implementing each alternative. Implementability issues become more significant as the complexity of the alternative increases and as the reliance on innovative technology increases. Implementability issues are important because they address the potential for delays, cost overruns, and remedy failure.

For this evaluation, overall effectiveness has been evaluated using the following the sub-criteria:

- **Technical Feasibility –** The potential for problems during implementation of the alternative and related uncertainties. The evaluation includes the likelihood of delays due to technical problems and the ease of modifying the alternative, if required.
- **Administrative Feasibility –** The degree of difficulty anticipated due to regulatory constraints and the degree of coordination required between various agencies.

Availability of services and materials is another consideration that can be used in evaluating implementability. However, the services and materials necessary to implement any of the alternatives are readily available. It is not a distinguishing factor for these alternatives, and is therefore not included as a sub-criterion.

10.2.1 Technical Feasibility

The alternatives use standard construction equipment and techniques. For these alternatives, the implementation difficulty increases slightly (technical feasibility decreases) with increasing excavation and with increasing treatment. In addition, because of difficulties associated with river protection, implementation difficulty increases with increased work along the river.

Alternative G involves the most excavation, the most treatment, and the most work along the river. Because of the time necessary to implement Alternative G (two seasons), the potential for fluctuating river and groundwater levels re-contaminating areas removed and cleaned is higher than with the other alternatives. For these reasons, Alternative G has a low technical feasibility.

Alternative D, E, and F are the next most difficult for all of these considerations. The difficulty in excavating to desired depths (below) previous excavation depths for the existing LNAPL geomembrane barrier may encounter boulders, concrete foundations, or tree stumps. Alternatives D, E, and F involve the same amount of river work, but Alternatives E and F are more difficult than Alternative D because they include treatment. Alternatives C1 and C2 are less difficult because they involve less river work and a shorter barrier/collector system and do not include treatment. Alternative A and B have the least technical difficulty because they do not include site construction.

Alternatives F and G are both given the lowest ranking because Alternative G has a higher potential for re-contamination of cleaned areas, whereas Alternative F has the difficulty in excavating the barrier/collection trench to the desired depth along the entire length of the LNAPL plume.

On this basis, the alternatives are ranked as follows for the technical feasibility sub-criteria (easiest to hardest):

1. (tie) Alternative A – No Further Action; Alternative B – Institutional Controls
2. (tie) Alternative C-1 – Focused Improvements in Containment and LNAPL Recovery Using a River Wall; Alternative C-2 – Focused Improvements in Containment and LNAPL Recovery Using a Trench
3. Alternative D – Complete Replacement of the Containment and LNAPL Recovery System
4. Alternative E – Complete Containment/Recovery Replacement and “Hot Spot” Treatment
5. (tie) Alternative F – Complete Containment/Recovery Replacement and Major Source Treatment; Alternative G – Treatment of the Entire LNAPL Plume Area

10.2.2 Administrative Feasibility

The administrative feasibility for the alternatives is primarily based on the expected relative difficulties in permitting construction in the river. Alternative G (Treatment of the Entire LNAPL Plume) involves the most extensive excavation along the river, followed by Alternatives D, E, and F (with a new LNAPL barrier/collection system for the entire length of the LNAPL plume), followed by Alternatives C1 and C2

(with a shorter new LNAPL barrier/collection system). Alternative G will also involve re-routing traffic on Highway 50 using a temporary road. This requirement will involve additional permitting requirements than the other alternatives.

Alternative C-1 is ranked relatively low because the concrete wall involves more work in the river than most of the other alternatives, with associated permit difficulties. In addition, because the river wall would be very visible, it could result in public opposition.

Implementation of institutional controls is relatively easy, but more difficult than no further action; therefore, Alternative A is ranked higher than Alternative B for this criterion.

On this basis, the alternatives are ranked as follows for the administrative feasibility sub-criteria (easiest to hardest):

1. Alternative A – No Further Action
2. Alternative B – Institutional Controls
3. Alternative C-2 – Focused Improvements in Containment and LNAPL Recovery Using a Trench
4. (tie) Alternative D – Complete Replacement of the Containment and LNAPL Recovery System; Alternative E – Complete Containment/Recovery Replacement and "Hot Spot" Treatment
5. Alternative F – Complete Containment/Recovery Replacement and Major Source Treatment
6. Alternative C-1 – Focused Improvements in Containment and LNAPL Recovery Using a River Wall
7. Alternative G – Treatment of the Entire LNAPL Plume Area

10.2.3 Overall Implementability

Combining the sub-criteria evaluations for implementability, the alternatives are ranked as follows for overall implementability (easiest to hardest to implement):

1. Alternative A – No Further Action
2. Alternative B – Institutional Controls
3. Alternative C-2 – Focused Improvements in Containment and LNAPL Recovery Using a Trench
4. (tie) Alternative C-1 – Focused Improvements in Containment and LNAPL Recovery Using a River Wall; Alternative D – Complete Replacement of the Containment and LNAPL Recovery System
5. Alternative E – Complete Containment/Recovery Replacement and "Hot Spot" Treatment
6. Alternative F – Complete Containment/Recovery Replacement and Major Source Treatment
7. Alternative G – Treatment of the Entire LNAPL Plume Area

10.3 Cost

Cost estimates have been prepared based on the descriptions of the alternatives and associated assumptions presented in Section 9. Summary cost estimates for comparison are presented in Table 10-1. Cost estimates for the alternatives are presented in Tables 10-2 through 10-9. Additional cost details are presented in Appendix L. These costs include capital, operations, maintenance, and monitoring costs on a net present value basis.

On the basis of these cost estimates, the alternatives are ranked as follows for cost (lowest to highest cost):

1. Alternative A – No Further Action
2. Alternative B – Institutional Controls
3. Alternative C-2 – Focused Improvements in Containment and LNAPL Recovery Using a Trench
4. Alternative C-1 – Focused Improvements in Containment and LNAPL Recovery Using a River Wall
5. Alternative D – Complete Replacement of the Containment and LNAPL Recovery System
6. Alternative E – Complete Containment/Recovery Replacement and "Hot Spot" Treatment
7. Alternative F – Complete Containment/Recovery Replacement and Major Source Treatment
8. Alternative G – Treatment of the Entire LNAPL Plume Area

10.4 Summary and Recommendations

Considering the evaluation criteria of effectiveness, implementability, and cost, Potlatch recommends Alternative B (Institutional Controls) as the preferred alternative. Alternative B would continue current LNAPL collection and removal operations, maintenance, and monitoring, plus add institutional controls as discussed in Section 9.1.1.

Alternative B would meet RAOs as follows:

- Institutional controls would prohibit future full-time residential use of the property, thereby preventing exposure of full-time residents to contaminated near-surface soils via direct contact and ingestion pathways. This institutional control would be implemented through a deed restriction.
- Institutional controls that prohibit drinking water wells at the Site would prevent exposure to contaminated groundwater by Site residents or visitors. This institutional control would be implemented through a deed restriction.
- Institutional controls that prohibit the development of a river water intake on the Site would reduce the risk of ingestion of contamination from the near-shore LNAPL recovery area. This institutional control would be implemented through a deed restriction. Prohibition of full-time residential use (first bullet above) would also reduce exposure of full-time residents to direct contact and ingestion of near-shore surface water impacted by LNAPL at the Site. In addition, warning signs installed along the shore would minimize

potential exposure of ingestion or direct contact by Site visitors approaching the LNAPL recovery area from either the land or river.

- Ongoing LNAPL recovery would protect surface water (beyond the near-shore LNAPL recovery area) from LNAPL releases, and thereby reduce the risk of direct contact and ingestion exposure of human and aquatic organisms to LNAPL on surface water. The LNAPL recovery area consists of a near-shore segment of the river approximately 200 feet long and 4 feet wide. This represents approximately 0.3% of the river surface adjacent to the Site. Therefore, the extremely small LNAPL recovery area provides ample opportunity for safe use of the river surface by humans and aquatic organisms.
- Natural attenuation would slowly reduce ecological exposure to impacted sediments in the St. Joe River. The impacted sediments occupy an area approximately 350 feet long and 6 feet wide. This represents approximately 0.7% of the river bed adjacent to the Site. The very limited extent of impacted sediments do not significantly affect the ecological processes, or populations of aquatic species, in the river adjacent to the site.

Potlatch is recommending Alternative B because not only does B address all RAOs, but the Company did not cause any contamination. The Company has already spent nearly $1 million on addressing contamination at a Site in which it has done nothing to contribute to the contamination and that a significant portion of the current contamination is located on property not owned by Potlatch. Moreover, a significant portion of contamination that is located on Potlatch's property migrated onto Potlatch's property from property not owned by Potlatch.

11.0 REFERENCES

Agency for Toxic Substances and Disease Registry (ATSDR), 2000. *Toxicological Profile for Manganese.* U.S. Department of Health and Human Services, Public Health Services, Agency for Toxic Substances and Disease Registry, Atlanta, GA.

Cassirer, E.F., C.R. Groves, and D. Genter.1993. Sensitive species management guide for the Coeur d'Alene salamander. Idaho Dept. Fish & Game, Boise, and the Montana Natural Heritage Program, Helena. 38pp.

Ecology and Environment, Inc. (E & E), April 10, 2007. *Avery Landing Site Site-Specific Sampling Plan*, prepared for the U.S. Environmental Protection Agency, Contract Number EP-S7-06-02, TDD 07-03-0004, Seattle, Washington.

EPA, 1986. *SW-846 Test Methods for Evaluating Solid Waste, Third Edition, Office of Solid Waste and Emergency Response*, USEPA, November, 1986, Rev. May, 1997.

EPA. 1989. Risk Assessment Guidance for Superfund (RAGS), Volume I, Human Health Evaluation Manual (Part A), Interim Final: EPA/540/1-89/002.

EPA, 1994. Environmental Monitoring Systems Laboratory, EPA, 1994.

EPA, 1995. Light Nonaqueous Phase Liquids. Ground Water Issue. U.S. Environmental Protection Agency. Authored by Charles J. Newell, Steven D. Acree, Randall R. Ross, and Scott G. Huling. EPA/540/S-95/500.

EPA. 2001. Final RI Report Coeur d'Alene Basin RI/FS. EPA Region 10. Work Assignment No. 027-RI-CO-102Q. September 2001.

EPA. 2002. National Recommended Water Quality Criteria. EPA 822-R-02-047.

EPA, 2004a. *USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review*, Final, Office of Superfund Remediation and Technology Innovation, US Environmental Protection Agency, Washington, DC. OSWER 9240.1-45. October, 2004.

EPA, 2004b. *Drinking Water Health Advisory for Manganese.* Office of Water, Health and Ecological Criteria Division. US Environmental Protection Agency, Washington, DC. EPA-822-R-04-003. January 2004.

EPA, 2006. Freshwater Sediment Screening Benchmarks. http://www.epa.gov/reg3hwmd/risk/eco/btag/sbv/fwsed/screenbench.htm, August.

EPA, 2007. USEPA *National Functional Guidelines for Superfund Organic Methods Data Review*, Final, Office of Superfund Remediation and Technology Innovation, US Environmental Protection Agency, Washington, DC.OSWER 540-R-07-003, July, 2007.

EPA undated. Consumer Fact Sheet. "PCBs". http://www.epa.gov/safewater/pdfs/factsheets/soc/pcbs.pdf. Accessed on 12/11/09.

EPA, undated. Consumer Fact Sheet. "Antimony". http://www.epa.gov/safewater/pdfs/factsheets/ioc/antimony.pdf. Accessed on 12/11/09.

EPA, undated. Technical Fact Sheet. "Antimony". http://www.epa.gov/safewater/pdfs/factsheets/ioc/tech/antimony.pdf. Accessed on 12/11/09.

Farallon Consulting, L.L.C. (Farallon), March 17, 2006. *Failure Analysis and Preliminary Corrective Action Work Plan, Avery Landing Site, Avery, Idaho*.

Golder, 2009. *'Field Sampling and Analysis Plan for the Engineering Evaluation/ Cost Analysis Work Plan'*, Avery Landing Site, Avery, Idaho. Attachment B, Submitted to Terry Cundy, Potlatch Land and Lumber, LLC, by Golder Associates Inc., November, 2009.

Hart Crowser, October 27, 1989. *Site Exploration Report, Avery Landing Avery, Idaho*, prepared for Potlatch Corporation.

Hart Crowser, December 2, 1993. *Proposed Draft Replacement for Free Phase Recovery Completion Section in the Draft Consent Order and Remediation Plan,* prepared for Potlatch Corporation.

Hart Crowser, December 29, 1993. *Results of December 1993 Site Visit and Testing, Avery Landing*, prepared for Potlatch Corporation.

Hart Crowser, November 22, 1993. *Report of Sampling and Analyses, Avery Landing*, prepared for Potlatch Corporation. November 22, 1993

Hart Crowser, May 2, 1994. *Implementation Work Plan and Revised Costs for Recovery System, Avery Landing, Idaho.*

Hart Crowser, July 27, 1994. *Draft Final Design of Free Product Recovery System (FPRS), Avery Landing, Idaho*, prepared for Potlatch Corporation.

Hart Crowser, November, 1994. *Laboratory Results for Excavated Soils Avery Landing Recovery System*, prepared for Potlatch Corporation.

Hart Crowser, August 7, 2000. *Corrective Action Plan, Avery Landing Site, Avery, Idaho*, prepared for Potlatch Corporation.

Hart Crowser, August 7, 2000. *Site Characterization Report (SCR) and Second Quarter Performance Report – Avery Landing*, prepared for Potlatch Corporation.

Hart Crowser, September 5, 2000. *Addendum No. 1 for Corrective Action Plan, Avery Landing, Avery, Idaho*, prepared for Potlatch Corporation.

Hart Crowser, Inc. (Hart Crowser), December 15, 2000. *Remediation System Installation and Third Quarter 2000 Performance Report, Avery Landing Recover System*, prepared for Potlatch Corporation.

Idaho Department of Environmental Quality (IDEQ), May 9, 1991. *Preliminary Assessment (PA) Avery Railroad Dump and Roundhouse, Avery. Idaho*, prepared for the U. S. Environmental Protection Agency, Region X, Superfund Program Management Section.

Idaho Department of Fish and Game. 2005. *Comprehensive Wildlife Conservation Strategy*. Boise, Idaho.

Idaho Department of Environmental Quality. 2004. Risk Evaluation Manual. Boise, Idaho.

Idaho Department of Environmental Quality. 2009. Idaho Administrative Code (IDAPA 58.01.02). Boise, Idaho.

Idaho Department of Environmental Quality. 2009. Boise, Idaho. http://www.deq.idaho.gov/Applications/Brownfields/index.cfm?site=risk.htm

Johnson, Stanley W, 2003. The Milwaukee Road In Idaho, A guide to Sites and Locations. Copyright ©2003 Museum of Northern Idaho.

Lewis 2002. Geologic Map of Shoshone County, Idaho. Digital Atlast of Idaho.

Link, P.K., Fanning, C.M., Lund, K.I., and Aleinikoff, J.N., 2007 in press, Detrital Zircons, Correlation and Provenance of Mesoproterozoic Belt Supergroup and Correlative Strata of East-Central Idaho and Southwest Montana: *in* Link, P.K., and Lewis, R.S., *eds*., SEPM Special Publication 86, Proterozoic Geology of Western North America and Siberia, p.101-128.

MacDonald, D.D., C.G. Ingersoll, and T.A. Berger. 2000 Development and Evaluation of Consensus-Based Sediment Quality Guidelines for Freshwater Ecosystems". Presented in Environmental Contamination and Toxicology. 39, pages 20-31. January.

Minnesota Pollution Control Agency, 2008. *Soil Sample Collection and Analysis Procedures*. Guidance Document 4-04. Petroleum Remediation Program. September 2008.

National Oceanic and Atmospheric Administration (NOAA), 2008. National Climatic Data Center. http://www.nws.noaa.gov/

Oregon Department of Human Services, undated. *Iron (Fe) and Manganese (Mn) in Groundwater*. http://www.oregon.gov/DHS/ph/dwp/docs/gwater/FeMnInGroundwater.pdf

Peel, MC et al. 2007 Updated World Map of the Koppen-Geiger Climate Classification. Hydrology and Earth Systems Science Discussions, Volume 4, pp. 439-473.

"Proceedings of the Subregional Awareness Raising Workshop on Persistent Organic Pollutants (POPs), Bangkok, Thailand". *United Nations Environment Programme*. November 25-28th, 1997. http://www.chem.unep.ch/pops/POPs_Inc/proceedings/bangkok/FIEDLER1.html. Reviewed 12/11/2009. As cited in Wikipedia article on "PCB".

Ross, G.M., and Villeneuve, M., 2003, Provenance of the Mesoproterozoic (1.45 Ga) Belt Basin (western North America): Another Piece in the Pre-Rodinia Paleogeographic Puzzle: Geological Society of America Bulletin, Volume 115, pp. 1191-1217.

State of Montana. http://fwp.mt.gov/wildthings/tande/bullTrout.html

URS Consultants, Inc. (URS), January 19, 1993. *Site Inspection Report for the Avery Railroad Dump and Roundhouse Site, CERCLIS ID No. IDD984666313*, prepared for the U.S. Environmental Protection Agency, Contract No. 68-W9-0054, Work Assignment No. 54-17-0JZZ, Seattle, Washington.

U.S. Department of the Interior Bureau of Land Management (BLM), October 2004. *Risk Mangement Criteria for Metals at BLM Mining Sites*. Technical Note 390 rev. BLM/RS/ST-97/001+1703.

Wagner, Warren R. 1949. *The Geology of Part of the South Slope of the St. Joe Mountains, Shoshone County, Idaho.* Idaho Bureau of Mines and Geology. February 1949.

Washington State Department of Ecology, 1994. "Natural Background Soil Metals Concentrations in Washington State." Toxics Cleanup Program. Publication #94-115. October 1994.

Washington State Department of Ecology, 1997; *Washington State Department of Ecology Analytical Methods for Petroleum Hydrocarbons*, Pub.No. ECY 97-602, June, 1997.

Washington State Department of Ecology, 2002 (Revised November 2007). Model Toxics Control Act Regulations (WAC 173-340). Olympia, Washington. WAC 173-340.

Western Regional Climate Center, 2006. Avery Ranger Station 2, Idaho (#100528) Period of Record Monthly Climate Summary 11/1/1968 to 12/31/2005. http://www.wrcc.dri.edu/cgi-bin/cliRECtM.pl?idave2

TABLES

TABLE 3-1
Test Pit Soil Results

Type	Analytes	Method	Screening Level mg/Kg	Sample ID	GTP1-2.5-082709	GTP1-10.5-082709	GTP1-13.5-082709	GTP2-2.5-082709	GTP2-8-082709	GTP2-13-082709	GTP3-3.5-082709	GTP3-5-082709	GTP3-13.5-082709	GTP4-2.5-082709	GTP4-6.0-082709	GTP4-8.0-082709	GTP5-3.0-082709	GTP5-7.0-082709	GTP5-11-082809	GTP6-2.5-082809	GTP6-10-082809	GTP6-17-082809
				Collection Date	8/27/2009	8/27/2009	8/27/2009	8/27/2009	8/27/2009	8/27/2009	8/27/2009	8/27/2009	8/27/2009	8/27/2009	8/27/2009	8/27/2009	8/27/2009	8/27/2009	8/28/2009	8/28/2009	8/28/2009	8/28/2009
				Units																		
TPH	Diesel Range Organics	NWTPH-Dx	NSA	mg/kg dry	452	8670	1630	24.7	< 11.5	< 12.7	44.2	770	23.7	25.6	11.3	< 16.1	< 16.8	774	342 J	< 11.4	9660	431
	Heavy Oils	NWTPH-Dx	NSA	mg/kg dry	3850	12800	2900	252	< 28.8	< 31.7	209	999	61.4	145	41.9	< 40.1	< 41.9	1090	985 J	< 28.4	3150	1200
PCBs	Aroclor 1016	8082	3.9	mg/kg dry	< 0.0096	< 0.0098	< 0.0096	< 0.0099	< 0.0097	< 0.0096	< 0.0099	< 0.0096	0.0098 UJ	< 0.0097	< 0.0099	< 0.0099	0.0098 UJ	< 0.012	< 0.0096	< 0.0096	< 0.0094	< 0.0099
	Aroclor 1221	8082	0.17	mg/kg dry	< 0.0096	< 0.0098	< 0.0096	< 0.0099	< 0.0097	< 0.0096	< 0.0099	< 0.0096	< 0.0098	< 0.0097	< 0.0099	< 0.0099	0.0098 UJ	< 0.012	< 0.0096	< 0.0096	< 0.0094	< 0.0099
	Aroclor 1232	8082	0.17	mg/kg dry	< 0.0096	< 0.0098	< 0.0096	< 0.0099	< 0.0097	< 0.0096	< 0.0099	< 0.0096	< 0.0098	< 0.0097	< 0.0099	< 0.0099	0.0098 UJ	< 0.012	< 0.0096	< 0.0096	< 0.0094	< 0.0099
	Aroclor 1242	8082	0.22	mg/kg dry	< 0.0096	< 0.0098	< 0.0096	< 0.0099	< 0.0097	< 0.0096	< 0.0099	< 0.0096	< 0.0098	< 0.0097	< 0.0099	< 0.0099	0.0098 UJ	< 0.012	< 0.0096	< 0.0096	< 0.0094	< 0.0099
	Aroclor 1248	8082	0.22	mg/kg dry	< 0.0096	< 0.0098	< 0.0096	< 0.0099	< 0.0097	< 0.0096	< 0.0099	< 0.0096	< 0.0098	< 0.0097	< 0.0099	< 0.0099	0.0098 UJ	< 0.012	< 0.0096	< 0.0096	< 0.0094	< 0.0099
	Aroclor 1254	8082	0.22	mg/kg dry	< 0.0096	< 0.0098	< 0.0096	< 0.0099	< 0.0097	< 0.0096	< 0.0099	< 0.0096	< 0.0098	< 0.0097	< 0.0099	< 0.0099	0.0098 UJ	< 0.012	< 0.0096	< 0.0096	< 0.0094	< 0.0099
	Aroclor 1260	8082	0.22	mg/kg dry	< 0.0096	< 0.0098	< 0.0096	0.0223	< 0.0097	< 0.0096	< 0.0099	< 0.0096	0.0098 UJ	0.0185	< 0.0099	< 0.0099	0.0098 UJ	< 0.012	< 0.0096	< 0.0096	< 0.0094	< 0.0099
Carcinogenic PAH	Benzo(a)anthracene	8270 SIM	0.15	mg/kg dry	0.0459	**0.348**	0.0737 J	0.0168	0.00820	< 0.00465	< 0.00467	0.0295	< 0.00474	< 0.00492	< 0.00500	< 0.00500	< 0.00447	< 0.00689	< 0.0254	< 0.00455	0.00767	0.0130
	Benzo(a)pyrene	8270 SIM	0.02	mg/kg dry	**0.0561**	**0.301**	**0.0259 J**	0.0162	0.00769	< 0.00465	< 0.00467	**0.0350**	< 0.00474	0.00516	< 0.00500	< 0.00500	< 0.00447	< 0.00689	< 0.0254	< 0.00455	0.00488	0.0110
	Benzo(b)fluoranthene	8270 SIM	0.15	mg/kg dry	0.0968	< 0.0831	0.0518 J	0.0335	0.0123	< 0.00465	0.00958	0.0627	< 0.00474	0.0117	0.00953	< 0.00500	< 0.00447	< 0.00689	< 0.0254	< 0.00455	< 0.00471	0.0178
	Benzo(k)fluoranthene	8270 SIM	1.5	mg/kg dry	< 0.0268	< 0.0831	< 0.00495 R	< 0.00471	< 0.00461	< 0.00465	< 0.00467	< 0.00645	< 0.00474	< 0.00492	< 0.00500	< 0.00500	< 0.00447	< 0.00689	< 0.0254	< 0.00455	< 0.00471	< 0.00514
	Chrysene	8270 SIM	15	mg/kg dry	0.0382	0.989	0.168 J	0.0178	0.00871	< 0.00465	0.00670	0.0725	< 0.00474	0.00609	< 0.00500	< 0.00500	< 0.00447	< 0.00689	< 0.0254	< 0.00455	0.0153	0.0178
	Dibenzo(a,h)anthracene	8270 SIM	0.02	mg/kg dry	< 0.0268	**0.245**	**0.0290 J**	0.00785	< 0.00461	< 0.00465	< 0.00467	0.0154	< 0.00474	< 0.00492	< 0.00500	< 0.00500	< 0.00447	< 0.00689	< 0.0254	< 0.00455	< 0.00471	0.00549
	Indeno(1,2,3-cd)pyrene	8270 SIM	0.15	mg/kg dry	0.0510	**0.277**	0.0269 J	0.0126	0.00461	< 0.00465	0.00862	0.0264	< 0.00474	< 0.00492	< 0.00500	< 0.00500	< 0.00447	< 0.00689	< 0.0254	< 0.00455	< 0.00471	0.00617
Non- Carcinogenic PAH	Acenaphthene	8270 SIM	52.3	mg/kg dry	< 0.0268	0.498	0.00508 J	< 0.00471	< 0.00461	< 0.00465	< 0.00467	< 0.00645	< 0.00474	< 0.00492	< 0.00500	< 0.00500	< 0.00447	< 0.00689	< 0.0254	< 0.00455	0.172 J	< 0.00514
	Acenaphthylene	8270 SIM	78	mg/kg dry	< 0.0268	< 0.0831	< 0.00495 R	< 0.00471	< 0.00461	< 0.00465	< 0.00467	< 0.00645	< 0.00474	< 0.00492	< 0.00500	< 0.00500	< 0.00447	< 0.00689	< 0.0254	< 0.00455	< 0.00471	< 0.00514
	Anthracene	8270 SIM	1040	mg/kg dry	< 0.0268	1.55	0.198 J	< 0.00471	< 0.00461	< 0.00465	< 0.00467	0.805	< 0.00474	< 0.00492	< 0.00500	< 0.00500	< 0.00447	< 0.00689	< 0.0254	< 0.00455	0.754	0.00823
	Benzo(g,h,i)perylene	8270 SIM	1178	mg/kg dry	0.0637	0.459	0.0345 J	0.0204	0.00666	< 0.00465	0.0105	0.0541	< 0.00474	0.00985	< 0.00500	< 0.00500	< 0.00447	< 0.00689	< 0.0254	< 0.00455	0.0209	0.0103
	Fluoranthene	8270 SIM	364	mg/kg dry	< 0.0268	0.150	0.0452 J	0.0257	0.00820	< 0.00465	0.00527	0.141	< 0.00474	0.00656	0.00524	< 0.00500	< 0.00447	0.0579	< 0.0254	< 0.00455	0.0914	0.0151
	Fluorene	8270 SIM	54.8	mg/kg dry	< 0.0268	1.41	0.0853 J	< 0.00471	< 0.00461	< 0.00465	< 0.00467	0.00984	< 0.00474	< 0.00492	< 0.00500	< 0.00500	< 0.00447	< 0.00689	< 0.0254	< 0.00455	0.207 J	0.00549
	Naphthalene	8270 SIM	1.14	mg/kg dry	< 0.0268	0.427	0.0818	< 0.00471	< 0.00461	< 0.00465	< 0.00467	< 0.00645	< 0.00474	< 0.00492	< 0.00500	< 0.00500	< 0.00447	0.0147	< 0.0254	< 0.00455	**2.39 J**	0.0185
	Phenanthrene	8270 SIM	79	mg/kg dry	< 0.0268	0.894	0.0635 J	0.00628	< 0.00461	< 0.00465	0.00527	0.0799	< 0.00474	< 0.00492	< 0.00500	< 0.00500	< 0.00447	0.0340	< 0.0254	< 0.00455	< 0.00471	0.0130
	Pyrene	8270 SIM	359	mg/kg dry	0.133	2.25	0.396 J	0.0398	0.0138	< 0.00465	0.0101	0.168	< 0.00474	0.0136	0.00905	< 0.00500	< 0.00447	0.295	< 0.0254	< 0.00455	0.112	0.0343
	1-Methylnaphthalene	8270 SIM	22	mg/kg dry	< 0.0268	< 0.0831	0.0579	< 0.00471	< 0.00461	< 0.00465	< 0.00467	0.0105	< 0.00474	< 0.00492	< 0.00500	< 0.00500	< 0.00447	0.00826	< 0.0254	< 0.00455	20.9 J	0.0412
	2-Methylnaphthalene	8270 SIM	310	mg/kg dry	< 0.0268	< 0.0831	< 0.00495	< 0.00471	< 0.00461	< 0.00465	< 0.00467	0.0105	< 0.00474	< 0.00492	< 0.00500	< 0.00500	< 0.00447	< 0.00689	< 0.0254	< 0.00455	39.1 J	0.0658
Total Metals	Aluminum	6010 / 6020	77000	mg/kg dry	8200	10000 J	6800	14000	15000	9400	13000	9200	16000	9100	14000	6000	10000	6300	5100	11000	6100	7100 J
	Arsenic	6010 / 6020	0.4	mg/kg dry	**8**	**5.7**	**11**	**18**	**32**	**21**	**8.5**	**8.9**	**45**	**20**	**28**	**9.4**	**15**	**3.6**	**3.7**	**17**	**4.7**	**8.3**
	Antimony	6010 / 6020	4.8	mg/kg dry	**13**	0.45	1.3	2.1	1.1	0.44	0.85	1.1	0.87	1.3	1.6	0.62	1.5	0.42 U	1.9	0.89	0.64	1.8
	Barium	6010 / 6020	896	mg/kg dry	**1100**	76	64	240	100	61	88	180	110	87	130	39	63	150	27	78	89	54
	Beryllium	6010 / 6020	1.63	mg/kg dry	1.1	0.37	0.29	**10**	0.61	0.37	0.82	0.51	0.75	0.45	0.81	0.22 U	0.55	0.32 U	0.25	0.52	0.32 U	0.3
	Calcium	6010 / 6020	NSA	mg/kg dry	8800	1600	1500	6400	2100	1500	5200	5300	1800	2500	3600	900	2700	5900	3200	5400	2800	2100
	Cadmium	6010 / 6020	1.35	mg/kg dry	0.42	0.26 U	0.21 U	0.94	0.3	0.18 J	0.27	0.28	0.32	0.34	0.61	0.22 U	0.31	0.32 U	0.19 J	0.34	0.32 U	0.29
	Chromium	6010 / 6020	2135	mg/kg dry	8.6	11	7.6	13	16	11	12	10	18	11	14	7.2	8.3	5.3	6.2	9.4	6.4	8.8
	Cobalt	6010 / 6020	23	mg/kg dry	7.6	6.8 J	8.9	7.5	8.2	6.5	8.7	5.9	12	9.2	11	5.1	12	4	4.4	11	4.3	6.2
	Copper	6010 / 6020	921	mg/kg dry	160	18	31	50	19	19	23	31	29	49	63	27	22	16	70	26	17	50 J
	Iron	6010 / 6020	5.8	mg/kg dry	**13000**	**15000 J**	**13000**	**16000**	**16000**	**13000**	**15000**	**12000**	**20000**	**14000**	**19000**	**12000**	**18000**	**7800**	**9000**	**18000**	**9500**	**12000 J**
	Lead	6010 / 6020	49.6	mg/kg dry	**410**	8.4	16	**140**	22	7.2	**72**	44	11	**53**	**55**	21	9.3	7.4	41	11	34	34
	Magnesium	6010 / 6020	NSA	mg/kg dry	2700	5700	3900	4300	8800	4600	9600	5300	6100	3300	3300	3200	4400	2800	2900	3500	2700	3500 J
	Manganese	6010 / 6020	223	mg/kg dry	**240**	130	140	**370**	**490**	**370**	**520**	**400**	**560**	**320**	**500**	**260**	**540**	**330**	49	**500**	200	200
	Mercury	7470A / 7471B	0.0051	mg/kg dry	**0.0083 J**	**0.015 J**	**0.013 J**	**0.027**	**0.024**	< 0.024	**0.018 J**	**0.11**	< 0.026	**0.016 J**	**0.022**	**0.012 J**	**0.025**	<0.040	**0.014 J**	**0.018 J**	**0.023 J**	**0.017 J**
	Nickel	6010 / 6020	59.1	mg/kg dry	25	13	12	17	15	11	13	13	19	14	25	11	17	6.7	16	18	7.7	12 J
	Potassium	6010 / 6020	NSA	mg/kg dry	780	1400	1200	1900	3200	1600	2900	2100	2800	1200	1500	1100	1600	1700	660	1400	1500	1200
	Selenium	6010 / 6020	2	mg/kg dry	0.4 J	0.19 J	0.2 J	0.36 J	0.094 J	0.14 J	0.1 J	0.16 J	0.15 J	0.16 J	0.19 J	0.063 J	0.13 J	0.063 J	0.11 J	0.11 J	0.023 J	0.1 J
	Silver	6010 / 6020	0.19	mg/kg dry	< 1.1	< 1.3	< 1.0	< 1.2	< 1.1	< 1.2	< 1.1	< 1.3	< 1.2	< 1.0	< 1.1	< 1.1	< 1.0	< 2.1	< 1.1	< 1.1	< 1.6	< 1.4
	Sodium	6010 / 6020	NSA	mg/kg dry	170 J	130 UJ	100 UJ	43 J	110 UJ	120 UJ	110 UJ	130 UJ	120 UJ	100 UJ	110 UJ	110 UJ	100 UJ	210 UJ	110 UJ	110 UJ	160 UJ	140 UJ
	Thallium	6010 / 6020	1.55	mg/kg dry	0.45 U	0.53 U	0.41 U	0.47 U	0.45 U	0.50 U	0.42 U	0.51 U	0.49 U	0.15 U	0.42 U	0.43 U	0.42 U	0.83 U	0.44 U	0.43 U	0.64 U	0.55 U
	Vanadium	6010 / 6020	2.4	mg/kg dry	**37**	**26**	**18**	**24**	**24**	**19**	**19**	**19**	**34**	**18**	**29**	**13**	**16**	**11**	**18**	**18**	**11**	**16**
	Zinc	6010 / 6020	886	mg/kg dry	70	34 J	25	180	30	31	72	72	40	66	90	57	27	49	65	28	37	46 J

Notes:

Bold - Detection is above media Screening Levels
NSA - No screening level available.
" < " - The analyte is not detected above the reporting quantitation limit.
U - Analyte not detected above the reported amount as a result of validation rules.
J - The analyte is positively idenitifed. However, the result is an estimated value.
UJ - The analyte was not detected above the reporting quantitation limit. However the reporting limit is approximate.
R - The data is rejected due to a deficiency in quality control criteria.

TABLE 3-1
Test Pit Soil Results

Type	Analytes	Method	Screening Level mg/Kg	Units	Sample ID	GTP1-2.5-082709	GTP1-10.5-082709	GTP1-13.5-082709	GTP2-2.5-082709	GTP2-8-082709	GTP2-13-082709	GTP3-3.5-082709	GTP3-5-082709	GTP3-13.5-082709	GTP4-2.5-082709	GTP4-6.0-082709	GTP4-8.0-082709	GTP5-3.0-082709	GTP5-7.0-082709	GTP5-11-082809	GTP6-2.5-082809	GTP6-10-082809	GTP6-17-082809
					Collection Date	8/27/2009	8/27/2009	8/27/2009	8/27/2009	8/27/2009	8/27/2009	8/27/2009	8/27/2009	8/27/2009	8/27/2009	8/27/2009	8/27/2009	8/27/2009	8/27/2009	8/28/2009	8/28/2009	8/28/2009	8/28/2009
Semivolatiles	1-Methylnaphthalene	8270C	22	mg/kg dry		0.023 J	< 0.41	< 0.32	< 0.36	< 0.0035	< 0.0078	0.001 J	0.012	< 0.0078	0.0086	< 0.033	< 0.0034	< 0.0032	0.016	< 0.066	0.0016 J	**45**	0.33
	2-Methylnaphthalene	8270C	310	mg/kg dry		< 0.23	< 0.27	< 0.21	< 0.24	< 0.0023	< 0.0052	0.0023 J	0.013	< 0.0052	0.015	< 0.022	0.00031 J	< 0.0022	0.01	< 0.044	0.002 J	78	0.48
	2-Methylphenol	8270C	1.8	mg/kg dry		< 1.1	< 1.4	< 1.1	< 1.2	< 0.012	< 0.026	< 0.022	0.005 J	< 0.026	< 0.021	< 0.11	< 0.011	< 0.011	< 0.020	< 0.22	< 0.011	< 0.16	< 0.028
	3 & 4 Methylphenol	8270C	NSA	mg/kg dry		< 2.3	< 2.7	< 2.1	< 2.4	< 0.023	< 0.052	< 0.044	0.066	< 0.052	< 0.042	< 0.22	< 0.023	< 0.022	< 0.041	< 0.44	< 0.022	< 0.33	< 0.056
	Acenaphthene	8270C	52	mg/kg dry		< 0.23	1.6	< 0.21	< 0.24	< 0.0023	< 0.0052	0.00082 J	< 0.0055	< 0.0052	< 0.0042	< 0.022	< 0.0023	< 0.0022	< 0.0041	< 0.044	< 0.0022	1.2	0.029
	Acenaphthylene	8270C	78	mg/kg dry		< 0.23	< 0.27	< 0.21	< 0.24	0.00072 J	< 0.0052	< 0.0044	< 0.0055	< 0.0052	0.0025 J	< 0.022	< 0.0023	< 0.0022	< 0.0041	< 0.044	< 0.0022	< 0.033	< 0.0056
	Anthracene	8270C	1040	mg/kg dry		< 0.23	< 0.27	< 0.21	< 0.24	0.00084 J	< 0.0052	0.0016 J	< 0.0055	< 0.0052	0.0031 J	0.0052 J	< 0.0023	< 0.0022	< 0.0041	< 0.044	< 0.0022	< 0.033	0.0088
	Benzo[a]anthracene	8270C	0.15	mg/kg dry		0.1 J	**0.36**	0.062	< 0.3	0.0057	0.001 J	0.0073	0.049	< 0.0065	0.0055	0.01 J	0.00068 J	< 0.0027	< 0.0051	< 0.055	< 0.0028	0.026 J	0.051
	Benzo[a]pyrene	8270C	0.015	mg/kg dry		< 0.34	**0.59**	**0.057**	**0.072 J**	0.0047	0.00086 J	0.0065 J	**0.037**	< 0.0078	0.0071	0.01 J	0.0013 J	0.0008 J	< 0.0061	< 0.066	0.0016 J	< 0.049	0.041
	Benzo[b]fluoranthene	8270C	0.15	mg/kg dry		< 0.23	< 0.27	< 0.21	< 0.24	0.0057	< 0.0052	0.0099	0.054	< 0.0052	0.0099	0.0076 J	0.00082 J	0.00091 J	< 0.0041	< 0.044	0.00098 J	< 0.033	0.049
	Benzo[g,h,i]perylene	8270C	1178	mg/kg dry		0.18 J	< 0.34	< 0.27	< 0.3	0.002 J	< 0.0065	0.0066	0.021	< 0.0065	0.016	0.006 J	< 0.0028	0.00086 J	< 0.0051	< 0.055	0.0011 J	< 0.041	0.024
	Benzo[k]fluoranthene	8270C	1.5	mg/kg dry		< 0.28	< 0.34	< 0.27	< 0.3	0.0018 J	< 0.0065	0.0028 J	0.011	< 0.0065	0.0023 J	0.0058 J	0.00019 J	0.00016 J	< 0.0051	< 0.055	0.00038 J	< 0.041	0.012
	bis(2-ethylhexyl) phthalate	8270C	11.8	mg/kg dry		< 17	< 20	< 16	< 18	< 0.17	< 0.39	0.12 J	0.3 J	< 0.39	0.15 J	< 2.7	< 0.28	< 0.27	< 0.51	< 5.5	< 0.28	< 4.1	< 0.70
	Butyl benzyl phthalate	8270C	260	mg/kg dry		< 1.1	< 1.4	< 1.1	< 1.2	< 0.012	< 0.026	0.014 J	< 0.027	< 0.026	< 0.31	< 1.6	< 0.17	< 0.16	< 0.31	< 3.3	< 0.17	< 2.5	< 0.42
	Benzoic Acid	8270C	77	mg/kg dry		< 28	< 34	< 27	< 30	< 0.29	< 0.32	< 0.55	< 0.68	< 0.65	< 0.021	< 0.11	< 0.011	< 0.011	< 0.020	< 0.22	< 0.011	< 0.16	< 0.028
	Carbazole	8270C	NSA	mg/kg dry		< 1.7	2.0 UJ	< 1.6	< 1.8	< 0.017	< 0.039	0.0015 J	< 0.041	< 0.039	0.0018 J	< 0.16	0.017 UJ	0.016 UJ	0.031 UJ	< 0.33	0.017 UJ	< 0.25	0.042 UJ
	Chrysene	8270C	15	mg/kg dry		0.11 J	1.9	0.34	< 0.3	0.0068	0.0017 J	0.01	0.1	0.012	0.0081	0.014 J	0.00045 J	< 0.0027	< 0.0051	< 0.055	< 0.0028	0.047	0.069
	Dibenzo(a,h)anthracene	8270C	0.015	mg/kg dry		< 0.45	< 0.54	< 0.43	< 0.49	< 0.0046	< 0.01	0.0014 J	0.0081 J	< 0.010	< 0.0084	< 0.044	< 0.0045	< 0.0043	< 0.0082	< 0.088	< 0.0045	< 0.065	0.0079 J
	Dibenzofuran	8270C	6.1	mg/kg dry		< 1.1	0.56 J	< 1.1	< 1.2	< 0.012	< 0.026	0.00085 J	< 0.027	< 0.026	< 0.021	< 0.11	< 0.011	< 0.011	< 0.020	< 0.22	< 0.011	< 0.16	< 0.028
	Diethyl phthalate	8270C	27.5	mg/kg dry		0.2 J	< 1.4	< 1.1	< 1.2	0.0019 J	0.002 J	0.0036 U	< 0.027	0.0069 U	0.0036 U	0.019 J	0.011 U	0.011 U	< 0.020	< 0.22	0.011 U	< 0.16	< 0.028
	Di-n-butyl phthalate	8270C	31	mg/kg dry		< 2.3	< 2.7	< 2.1	< 2.4	0.0071 U	0.0067 U	0.008	< 0.055	0.0091 U	0.01 U	< 0.22	0.023 U	0.022 U	0.2 J	< 0.44	0.022 U	0.33 U	< 0.056
	Di-n-octyl phthalate	8270C	1829	mg/kg dry		< 2.3	2.7 U	< 2.1	< 2.4	< 0.023	< 0.052	< 0.044	< 0.055	< 0.052	< 0.042	< 0.22	< 0.023	< 0.022	< 0.041	< 0.44	< 0.022	< 0.33	< 0.056
	Fluoranthene	8270C	364	mg/kg dry		< 0.23	1.0	0.13	0.089 J	0.0078	0.001 J	0.015	0.077	0.0021 J	0.0082	0.017 J	< 0.0023	< 0.0022	< 0.0041	< 0.044	< 0.0022	0.15	0.04
	Fluorene	8270C	54.8	mg/kg dry		< 0.23	4.5	0.38	< 0.24	< 0.0023	< 0.0052	0.0014 J	0.012	< 0.0052	< 0.0042	< 0.022	< 0.0023	< 0.0022	0.0082	< 0.044	< 0.0022	2.1	0.032
	Indeno[1,2,3-cd]pyrene	8270C	0.15	mg/kg dry		0.06 J	< 0.54	< 0.43	< 0.49	0.0024 J	< 0.01	0.0041 J	0.018	< 0.010	0.0073 J	0.0047 J	0.0006 J	0.00065 J	< 0.0082	< 0.088	0.0007 J	< 0.065	0.013
	Naphthalene	8270C	1.14	mg/kg dry		< 0.23	< 0.27	< 0.21	< 0.24	< 0.0023	< 0.0052	0.0012 J	0.0065	< 0.0052	0.0076	< 0.022	0.00027 J	< 0.0022	0.031	< 0.044	0.0011 J	**27**	0.096
	Phenanthrene	8270C	79	mg/kg dry		< 0.23	< 0.27	< 0.21	< 0.24	0.0029	< 0.0052	0.0092	0.083	< 0.0052	0.0064	0.0077 J	< 0.0023	< 0.0022	0.062	< 0.044	< 0.0022	2.4	0.051
	Phenol	8270C	7.4	mg/kg dry		< 1.1	< 1.4	< 1.1	< 1.2	< 0.012	< 0.013	< 0.022	<0.027	< 0.026	< 0.021	< 0.11	< 0.011	< 0.011	< 0.020	< 0.22	< 0.011	< 0.16	0.0095 J
	Pyrene	8270C	359	mg/kg dry		0.089 J	1.5	0.19	0.081 J	0.0087	0.0012 J	0.013	0.094	0.0046 J	0.0099	0.015 J	< 0.0023	< 0.0022	< 0.0041	0.012 J	< 0.0022	0.12	0.083
Volatiles	1,2,4-Trimethylbenzene	8260B	67	mg/kg dry		0.14 J	< 0.15	< 0.080	< 0.22	< 0.072	< 0.055	0.017 J	0.021 J	< 0.070	0.41	0.054 J	< 0.048	< 0.060	0.12 J	< 0.053	< 0.056	53	0.42
	1,2-Dichlorobenzene	8260B	5.25	mg/kg dry		< 0.15	< 0.15	< 0.080	< 0.22	< 0.072	< 0.055	< 0.10	< 0.088	< 0.070	< 0.044	< 0.061	< 0.048	< 0.060	< 0.16	< 0.053	< 0.056	< 0.14	< 0.089
	1,3,5-Trimethylbenzene	8260B	47	mg/kg dry		0.048 J	< 0.15	< 0.080	< 0.22	< 0.072	< 0.055	< 0.10	< 0.088	< 0.070	0.27	0.022 J	< 0.048	< 0.060	0.058 J	< 0.053	< 0.056	13	0.12
	1,4-Dichlorobenzene	8260B	0.076	mg/kg dry		< 0.15	< 0.15	< 0.080	< 0.22	< 0.072	< 0.055	< 0.10	< 0.088	< 0.070	< 0.044	< 0.061	< 0.048	< 0.060	< 0.16	< 0.053	< 0.056	< 0.14	< 0.089
	4-Isopropyltoluene	8260B	NSA	mg/kg dry		0.043 J	0.13 J	< 0.080	< 0.22	< 0.072	< 0.055	0.028 J	18	0.10	0.022 J	< 0.061	0.014 J	< 0.060	0.15 J	< 0.053	< 0.056	27	0.55
	Benzene	8260B	0.018	mg/kg dry		**0.044 J**	< 0.062	< 0.032	< 0.087	< 0.029	< 0.022	0.0097 J	< 0.035	< 0.028	**0.026**	< 0.025	< 0.019	< 0.024	< 0.062	< 0.021	< 0.022	**0.045 J**	< 0.036
	cis-1,2-Dichloroethene	8260B	0.19	mg/kg dry		< 0.15	< 0.15	< 0.080	< 0.22	< 0.072	< 0.055	< 0.10	< 0.088	< 0.070	< 0.044	< 0.061	< 0.048	< 0.060	< 0.16	< 0.053	< 0.056	< 0.14	0.095
	Ethylbenzene	8260B	5.7	mg/kg dry		0.14 J	0.081 J	< 0.080	< 0.22	< 0.072	< 0.055	0.012 J	0.072 J	< 0.070	0.039 J	0.0068 J	< 0.048	< 0.060	0.088 J	< 0.053	< 0.056	3.2	0.072 J
	Isopropylbenzene	8260B	3.46	mg/kg dry		< 0.15	0.1 J	0.014 J	< 0.22	< 0.072	< 0.055	< 0.10	< 0.088	< 0.070	0.0066 J	< 0.061	< 0.048	< 0.060	0.03 J	< 0.053	< 0.056	1.6	0.031 J
	Methylene Chloride	8260B	0.017	mg/kg dry		0.054 U	0.057 U	0.032 U	**1.6 J**	0.23 U	0.015 U	0.51 U	0.032 U	0.13 U	0.016 U	0.014 J	0.019 U	0.047 U	0.054 U	0.061 U	0.043 U	0.4 U	0.3 U
	m-Xylene & p-Xylene	8260B	1.67	mg/kg dry		0.41	0.12 J	0.016 J	0.048 J	< 0.072	< 0.055	0.061	0.025 J	0.014 J	0.59	0.087	0.012 J	< 0.060	< 0.16	< 0.053	< 0.056	**9**	0.16
	Naphthalene	8260B	1.14	mg/kg dry		< 0.15	< 0.15	< 0.080	< 0.22	< 0.072	< 0.055	0.067 J	0.05 J	< 0.070	0.14	< 0.061	< 0.048	< 0.060	0.09 J	< 0.053	< 0.056	**38**	0.36
	n-Butylbenzene	8260B	NSA	mg/kg dry		< 0.15	< 0.15	< 0.080	< 0.22	< 0.072	< 0.055	< 0.10	< 0.088	< 0.070	< 0.044	< 0.061	< 0.048	< 0.060	< 0.16	< 0.053	< 0.056	< 0.14	0.35
	N-Propylbenzene	8260B	NSA	mg/kg dry		0.031 J	0.094 J	< 0.080	< 0.22	< 0.072	< 0.055	< 0.10	0.056 J	< 0.070	0.019 J	< 0.061	< 0.048	< 0.060	< 0.16	< 0.053	< 0.056	4.3	0.053 J
	o-Xylene	8260B	1.67	mg/kg dry		0.17	0.052 J	< 0.080	0.017 J	< 0.072	< 0.055	< 0.10	0.01 J	0.0067 J	0.41	0.081	< 0.048	< 0.060	0.012 J	< 0.053	< 0.056	**5.5**	0.088 J
	sec-Butylbenzene	8260B	1.17	mg/kg dry		< 0.15	0.41	< 0.080	< 0.22	< 0.072	< 0.055	< 0.10	< 0.088	< 0.070	< 0.044	< 0.061	< 0.048	< 0.060	0.036 J	< 0.053	< 0.056	4.5	0.051 J
	tert-Butylbenzene	8260B	0.85	mg/kg dry		< 0.15	< 0.15	< 0.080	< 0.22	< 0.072	< 0.055	< 0.10	< 0.088	< 0.070	< 0.044	< 0.061	< 0.048	< 0.060	< 0.16	< 0.053	< 0.056	0.16	< 0.089
	Toluene	8260B	4.89	mg/kg dry		0.4	0.057 J	< 0.080	0.04 J	0.013 J	< 0.055	0.2	0.081 J	0.01 J	0.21	0.031 J	< 0.048	< 0.060	0.095 J	< 0.053	< 0.056	0.12 J	0.018 J
	Trichloroethene	8260B	0.0029	mg/kg dry		< 0.059	< 0.062	< 0.032	0.060 J	**0.17**	0.0011 J	< 0.042	< 0.035	< 0.028	< 0.018	< 0.025	< 0.019	< 0.024	< 0.062	0.00041 J	< 0.022	< 0.057	0.023 J

Notes:

Bold - Detection is above media Screening Levels
NSA - No screening level available.
" < " - The analyte is not detected above the reporting quantitation limit.
U - Analyte not detected above the reported amount as a result of validation rules.
J - The analyte is positively idenitifed. However, the result is an estimated value.
UJ - The analyte was not detected above the reporting quantitation limit. However the reporting limit is approximate.
R - The data is rejected due to a deficiency in quality control criteria.
1,2,4-Trimethylbenzene and 1,3,5-Trimethylbenzene screening values based on recent suspension of screening levels by IDEQ.

TABLE 3-1
Test Pit Soil Results

Type	Analytes	Method	Screening Level mg/Kg	Sample ID	GTP7-2.5-082809	GTP7-10.0-082809	GTP7-18-082809	TS-COMP-1	TS-COMP-2	TS-COMP-3
				Collection Date	8/28/2009	8/28/2009	8/28/2009	8/28/2009	8/28/2009	8/28/2009
				Units						
TPH	Diesel Range Organics	NWTPH-Dx	NSA	mg/kg dry	< 15.8	23.4	< 16.9	763	2120	1790
	Heavy Oils	NWTPH-Dx	NSA	mg/kg dry	42.2	182	< 42.3	263	1090	2050
PCBs	Aroclor 1016	8082	3.9	mg/kg dry	< 0.0097	< 0.0096	< 0.0099	< 0.0098	< 0.0097	< 0.0098
	Aroclor 1221	8082	0.17	mg/kg dry	< 0.0097	< 0.0096	< 0.0099	< 0.0098	< 0.0097	< 0.0098
	Aroclor 1232	8082	0.17	mg/kg dry	< 0.0097	< 0.0096	< 0.0099	< 0.0098	< 0.0097	< 0.0098
	Aroclor 1242	8082	0.22	mg/kg dry	< 0.0097	< 0.0096	< 0.0099	< 0.0098	< 0.0097	< 0.0098
	Aroclor 1248	8082	0.22	mg/kg dry	< 0.0097	< 0.0096	< 0.0099	< 0.0098	< 0.0097	< 0.0098
	Aroclor 1254	8082	0.22	mg/kg dry	< 0.0097	< 0.0096	< 0.0099	< 0.0098	< 0.0097	< 0.0098
	Aroclor 1260	8082	0.22	mg/kg dry	< 0.0097	< 0.0096	< 0.0099	0.0128	< 0.0097	0.0265
Carcinogenic PAH	Benzo(a)anthracene	8270 SIM	0.15	mg/kg dry	< 0.00492	< 0.00489	< 0.00451	0.0202	0.144	0.0258
	Benzo(a)pyrene	8270 SIM	0.02	mg/kg dry	< 0.00492	< 0.00489	< 0.00451	0.00777	< 0.0538	< 0.0155
	Benzo(b)fluoranthene	8270 SIM	0.15	mg/kg dry	< 0.00492	< 0.00489	< 0.00451	0.0155	0.108	0.0330
	Benzo(k)fluoranthene	8270 SIM	1.5	mg/kg dry	< 0.00492	< 0.00489	< 0.00451	< 0.00466	< 0.0538	< 0.0155
	Chrysene	8270 SIM	15	mg/kg dry	< 0.00492	< 0.00489	< 0.00451	0.0394	0.236	0.0733
	Dibenzo(a,h)anthracene	8270 SIM	0.02	mg/kg dry	< 0.00492	< 0.00489	< 0.00451	0.00829	< 0.0538	0.0165
	Indeno(1,2,3-cd)pyrene	8270 SIM	0.15	mg/kg dry	< 0.00492	< 0.00489	< 0.00451	0.00725	< 0.0538	0.0155
Non- Carcinogenic PAH	Acenaphthene	8270 SIM	52.3	mg/kg dry	< 0.00492	< 0.00489	< 0.00451	0.270	0.959	0.111 J
	Acenaphthylene	8270 SIM	78	mg/kg dry	< 0.00492	< 0.00489	< 0.00451	< 0.00466	< 0.0538	0.0186 J
	Anthracene	8270 SIM	1040	mg/kg dry	< 0.00492	< 0.00489	< 0.00451	0.206	1.24	0.167 J
	Benzo(g,h,i)perylene	8270 SIM	1178	mg/kg dry	< 0.00492	< 0.00489	< 0.00451	0.0104	< 0.0538	0.0217
	Fluoranthene	8270 SIM	364	mg/kg dry	< 0.00492	< 0.00489	< 0.00451	0.0233	0.379	0.0557 J
	Fluorene	8270 SIM	54.8	mg/kg dry	< 0.00492	< 0.00489	< 0.00451	0.374	1.39	0.184 J
	Naphthalene	8270 SIM	1.14	mg/kg dry	< 0.00492	< 0.00489	< 0.00451	0.114	**1.89**	0.109
	Phenanthrene	8270 SIM	79	mg/kg dry	< 0.00492	< 0.00489	< 0.00451	0.664	4.21	0.277 J
	Pyrene	8270 SIM	359	mg/kg dry	< 0.00492	< 0.00489	< 0.00451	0.110	1.05	0.275
	1-Methylnaphthalene	8270 SIM	22	mg/kg dry	< 0.00492	< 0.00489	< 0.00451	1.56	10.5	0.759
	2-Methylnaphthalene	8270 SIM	310	mg/kg dry	< 0.00492	< 0.00489	< 0.00451	1.52	14.2	0.459
Total Metals	Aluminum	6010 / 6020	77000	mg/kg dry	6800	5500	6200	9000	9200	6500
	Arsenic	6010 / 6020	0.4	mg/kg dry	**17**	**6.8**	**7.8**	**9**	**7.8**	**15**
	Antimony	6010 / 6020	4.8	mg/kg dry	0.97	0.36	0.49	0.8	1.4	1.2
	Barium	6010 / 6020	896	mg/kg dry	47	34	42	90	90	40
	Beryllium	6010 / 6020	1.63	mg/kg dry	0.36	0.21	0.27	0.35	0.38	0.29
	Calcium	6010 / 6020	NSA	mg/kg dry	25000	2000	1300	1500	1300	1100
	Cadmium	6010 / 6020	1.35	mg/kg dry	0.13 J	0.17 J	0.11 J	0.16 J	0.14 J	0.13 J
	Chromium	6010 / 6020	2135	mg/kg dry	6.2	7.3	7.6	9.9	9.8	7.4
	Cobalt	6010 / 6020	23	mg/kg dry	11	6.1	7	8	7.8	7.9
	Copper	6010 / 6020	921	mg/kg dry	23	20	21	25	45	23
	Iron	6010 / 6020	5.8	mg/kg dry	**16000**	**11000**	**12000**	**13000**	**12000**	**12000**
	Lead	6010 / 6020	49.6	mg/kg dry	9.3	7.4	7.3	12	19	15
	Magnesium	6010 / 6020	NSA	mg/kg dry	6300	3100	3500	5000	4500	3900
	Manganese	6010 / 6020	223	mg/kg dry	**520**	**270**	200	170	160	170
	Mercury	7470A / 7471B	0.0051	mg/kg dry	**0.013 J**	**0.017 J**	**0.015 J**	< 0.023	< 0.020	**0.016 J**
	Nickel	6010 / 6020	59.1	mg/kg dry	17	9.3	9.9	13	13	12
	Potassium	6010 / 6020	NSA	mg/kg dry	1200	1200	1400	1700	1200	1200
	Selenium	6010 / 6020	2	mg/kg dry	0.068 J	0.055 J	0.073 J	0.16 J	0.14 J	0.13 J
	Silver	6010 / 6020	0.19	mg/kg dry	< 1.0	< 1.0	< 1.1	< 1.2	< 1.0	< 1.0
	Sodium	6010 / 6020	NSA	mg/kg dry	100 UJ	100 UJ	110 UJ	120 UJ	100 UJ	100 UJ
	Thallium	6010 / 6020	1.55	mg/kg dry	0.41 U	0.40 U	0.42 U	0.46 U	0.42 U	0.41 J
	Vanadium	6010 / 6020	2.4	mg/kg dry	**10**	**12**	**16**	**23**	**21**	**17**
	Zinc	6010 / 6020	886	mg/kg dry	26	28	29	36	30	23

Type	Analytes	Method	Screening Level mg/Kg	Sample ID	GTP7-2.5-082809	GTP7-10.0-082809	GTP7-18-082809	TS-COMP-1	TS-COMP-2	TS-COMP-3
				Collection Date	8/28/2009	8/28/2009	8/28/2009	8/28/2009	8/28/2009	8/28/2009
				Units						
Semivolatiles	1-Methylnaphthalene	8270C	22	mg/kg dry	< 0.0032	0.00056 J	0.00031 J	5.5	10	0.78
	2-Methylnaphthalene	8270C	310	mg/kg dry	< 0.0021	0.00067 J	0.00046 J	4.6	9.5	0.38
	2-Methylphenol	8270C	1.8	mg/kg dry	< 0.011	< 0.011	< 0.011	< 0.24	< 0.22	< 1.1
	3 & 4 Methylphenol	8270C	NSA	mg/kg dry	< 0.021	< 0.022	< 0.022	< 0.47	< 0.44	< 2.2
	Acenaphthene	8270C	52	mg/kg dry	< 0.0021	< 0.0022	< 0.0022	0.81	1.5	0.2 J
	Acenaphthylene	8270C	78	mg/kg dry	0.00076 J	0.00083 J	< 0.0022	< 0.047	< 0.044	< 0.22
	Anthracene	8270C	1040	mg/kg dry	< 0.0021	0.0016 J	< 0.0022	0.11	0.28	0.068 J
	Benzo[a]anthracene	8270C	0.15	mg/kg dry	< 0.0027	0.0021 J	< 0.0028	0.049 J	0.1	< 0.27
	Benzo[a]pyrene	8270C	0.015	mg/kg dry	0.0016 J	0.0035	< 0.0033	**0.021 J**	**0.077**	< 0.33
	Benzo[b]fluoranthene	8270C	0.15	mg/kg dry	0.0021 J	0.005	< 0.0022	< 0.047	< 0.044	< 0.22
	Benzo[g,h,i]perylene	8270C	1178	mg/kg dry	0.0017 J	0.0033	< 0.0028	< 0.059	0.036 J	< 0.27
	Benzo[k]fluoranthene	8270C	1.5	mg/kg dry	0.00052 J	0.0018 J	< 0.0028	< 0.059	< 0.055	< 0.27
	bis(2-ethylhexyl)phthalate	8270C	11.8	mg/kg dry	< 0.27	< 0.27	< 0.28	< 5.9	< 5.5	< 27
	Butyl benzyl phthalate	8270C	260	mg/kg dry	< 0.16	< 0.16	0.17 UJ	< 3.5	< 3.3	< 16
	Benzoic Acid	8270C	77	mg/kg dry	< 0.011	< 0.011	< 0.011	< 0.24	< 0.22	< 1.1
	Carbazole	8270C	NSA	mg/kg dry	0.00059 J	0.001 UJ	< 0.017	< 0.35	< 0.33	< 1.6
	Chrysene	8270C	15	mg/kg dry	< 0.0027	0.0038	< 0.0028	0.088	0.26	< 0.27
	Dibenzo(a,h)anthracene	8270C	0.015	mg/kg dry	< 0.0043	0.00079 J	< 0.0044	< 0.095	< 0.087	< 0.44
	Dibenzofuran	8270C	6.1	mg/kg dry	< 0.011	< 0.011	< 0.011	< 0.24	< 0.22	< 1.1
	Diethyl phthalate	8270C	27.5	mg/kg dry	0.011 U	0.011 U	0.011 U	< 0.24	< 0.22	< 1.1
	Di-n-butyl phthalate	8270C	31	mg/kg dry	0.021 U	0.021 U	0.022 U	< 0.47	< 0.44	< 2.2
	Di-n-octyl phthalate	8270C	1829	mg/kg dry	< 0.021	< 0.022	< 0.022	< 0.47	0.054 J	< 2.2
	Fluoranthene	8270C	364	mg/kg dry	0.0012 J	0.0034	< 0.0022	0.072	0.54	< 0.22
	Fluorene	8270C	54.8	mg/kg dry	< 0.0021	< 0.0022	< 0.0022	1.2	2.6	0.52
	Indeno[1,2,3-cd]pyrene	8270C	0.15	mg/kg dry	0.0014 J	0.0025 J	< 0.0044	< 0.095	< 0.087	< 0.44
	Naphthalene	8270C	1.14	mg/kg dry	0.0004 J	0.00048 J	0.00039 J	0.19	0.83	< 0.22
	Phenanthrene	8270C	79	mg/kg dry	< 0.0021	0.00087 J	< 0.0022	1.6	4.7	0.47
	Phenol	8270C	7.4	mg/kg dry	< 0.011	< 0.011	< 0.011	< 0.24	< 0.22	< 1.1
	Pyrene	8270C	359	mg/kg dry	0.0015 J	0.0037	0.00039 J	0.13	0.57	0.19 J
Volatiles	1,2,4-Trimethylbenzene	8260B	67	mg/kg dry	< 0.049	< 0.041	< 0.039	0.048 J	0.13	< 0.041
	1,2-Dichlorobenzene	8260B	5.25	mg/kg dry	< 0.049	< 0.041	< 0.039	0.037 J	0.037	0.015 J
	1,3,5-Trimethylbenzene	8260B	47	mg/kg dry	< 0.049	< 0.041	< 0.039	< 0.060	0.0075 J	< 0.041
	1,4-Dichlorobenzene	8260B	0.076	mg/kg dry	< 0.049	< 0.041	< 0.039	< 0.060	< 0.030	0.0064 J
	4-Isopropyltoluene	8260B	NSA	mg/kg dry	0.0049 J	< 0.041	< 0.039	0.094	0.064	0.014 J
	Benzene	8260B	0.018	mg/kg dry	< 0.020	< 0.017	< 0.016	< 0.024	< 0.012	< 0.017
	cis-1,2-Dichloroethene	8260B	0.19	mg/kg dry	< 0.049	< 0.041	< 0.039	< 0.060	< 0.030	< 0.041
	Ethylbenzene	8260B	0.071	mg/kg dry	< 0.049	< 0.041	< 0.039	0.07	0.044	< 0.041
	Isopropylbenzene	8260B	3.46	mg/kg dry	< 0.049	< 0.041	< 0.039	0.16	0.082	0.069
	Methylene Chloride	8260B	0.017	mg/kg dry	0.03 U	0.011 U	0.017 U	0.081 U	0.066 U	< 0.041
	m-Xylene & p-Xylene	8260B	1.67	mg/kg dry	< 0.049	< 0.041	< 0.039	0.014 J	0.017 J	0..01 J
	Naphthalene	8260B	1.14	mg/kg dry	< 0.049	< 0.041	< 0.039	**1.9**	**2**	0.37
	n-Butylbenzene	8260B	NSA	mg/kg dry	< 0.049	< 0.041	< 0.039	0.71	< 0.030	0.61
	N-Propylbenzene	8260B	NSA	mg/kg dry	< 0.049	< 0.041	< 0.039	0.33	0.14	0.11
	o-Xylene	8260B	5300	mg/kg dry	< 0.049	< 0.041	< 0.039	< 0.060	0.02 J	< 0.041
	sec-Butylbenzene	8260B	1.17	mg/kg dry	< 0.049	< 0.041	< 0.039	0.28	0.12	0.29
	tert-Butylbenzene	8260B	0.85	mg/kg dry	< 0.049	< 0.041	< 0.039	0.02 J	0.014 J	0.015 J
	Toluene	8260B	4.89	mg/kg dry	< 0.049	< 0.041	< 0.039	0.0096 J	0.0053 J	< 0.041
	Trichloroethene	8260B	0.0029	mg/kg dry	< 0.020	< 0.017	< 0.016	< 0.024	< 0.012	< 0.017

Notes: **Bold -** Detection is above media Screening Levels
NSA - No screening level available.
" < " - The analyte is not detected above the reporting quantitation limit.
U - Analyte not detected above the reported amount as a result of validation rules.
J - The analyte is positively idenitifed. However, the result is an estimated value.
UJ - The analyte was not detected above the reporting quantitation limit. However the reporting limit is approximate.
R - The data is rejected due to a deficiency in quality control criteria.
1,2,4-Trimethylbenzene and 1,3,5-Trimethylbenzene screening values based on recent suspension of screening levels by IDEQ.

TABLE 3-2
Monitoring Well and Boring Soil Sample Results

Type	Analytes	Method	Screening Level mg/Kg	Sample ID	G-BH1-Surf-082809	G-BH1-7.5-082809	G-BH1-16-082809	G-BH2-Surf-082809	G-BH2-7.5-082809	G-BH2-15-082809	G-BH3-Surf-082709	G-BH3-7.5-082709	G-BH3-15-082709	G-BH4-Surf-082709	G-BH4-7.5-082709	G-BH4-15-082709	G-BH5-Surf-082709	G-BH5-7.5-082709	G-BH5-15-082709	G-GA1-21-082609	G-GA3-20-082609
				Collection Date	8/28/2009	8/28/2009	8/28/2009	8/28/2009	8/28/2009	8/28/2009	8/27/2009	8/27/2009	8/27/2009	8/27/2009	8/27/2009	8/27/2009	8/27/2009	8/27/2009	8/27/2009	8/27/2009	8/26/2009	8/26/2009
				Units																	
TPH	Diesel Range Organics	NWTPH-Dx	NSA	mg/kg dry	37.8	< 113	262	< 11	< 11.5	20.7	< 21.2	12.2	601	< 21.4	2380	19.2	30.1	1060	109	37.1 J	22.9 J
	Heavy Oils	NWTPH-Dx	NSA	mg/kg dry	349	201	96.4	60.1	< 28.8	50.7	91.1	37.5	345	68.6	1360	<31.3	201	703	170	73.0 J	70.7 J
PCBs	Aroclor 1016	8082	3.9	mg/kg dry	< 0.0099	< 0.010	< 0.0099	< 0.010	< 0.0097	< 0.0099	< 0.0098	< 0.0098	< 0.0099	< 0.0099	< 0.010	< 0.0095	< 0.0099	< 0.010	< 0.0097	< 0.0099	< 0.0096
	Aroclor 1221	8082	0.17	mg/kg dry	< 0.0099	< 0.010	< 0.0099	< 0.010	< 0.0097	< 0.0099	< 0.0098	< 0.0098	< 0.0099	< 0.0099	< 0.010	< 0.0095	< 0.0099	< 0.010	< 0.0097	< 0.0099	< 0.0096
	Aroclor 1232	8082	0.17	mg/kg dry	< 0.0099	< 0.010	< 0.0099	< 0.010	< 0.0097	< 0.0099	< 0.0098	< 0.0098	< 0.0099	< 0.0099	< 0.010	< 0.0095	< 0.0099	< 0.010	< 0.0097	< 0.0099	< 0.0096
	Aroclor 1242	8082	0.22	mg/kg dry	< 0.0099	< 0.010	< 0.0099	< 0.010	< 0.0097	< 0.0099	< 0.0098	< 0.0098	< 0.0099	< 0.0099	< 0.010	< 0.0095	< 0.0099	< 0.010	< 0.0097	< 0.0099	< 0.0096
	Aroclor 1248	8082	0.22	mg/kg dry	< 0.0099	< 0.010	< 0.0099	< 0.010	< 0.0097	< 0.0099	< 0.0098	< 0.0098	< 0.0099	< 0.0099	< 0.010	< 0.0095	< 0.0099	< 0.010	< 0.0097	< 0.0099	< 0.0096
	Aroclor 1254	8082	0.22	mg/kg dry	< 0.0099	< 0.010	< 0.0099	< 0.010	< 0.0097	< 0.0099	< 0.0098	< 0.0098	< 0.0099	< 0.0099	< 0.010	< 0.0095	< 0.0099	< 0.010	< 0.0097	< 0.0099	< 0.0096
	Aroclor 1260	8082	0.22	mg/kg dry	< 0.0099	< 0.010	< 0.0099	< 0.010	< 0.0097	< 0.0099	< 0.0098	< 0.0098	< 0.0099	< 0.0099	< 0.010	< 0.0095	< 0.0099	< 0.010	< 0.0097	< 0.0099	< 0.0096
Carcinogenic PAH	Benzo(a)anthracene	8270 SIM	0.15	mg/kg dry	<0.0048	<0.00452	< 0.00487	0.0059	0.00461	0.0426	< 0.00848	< 0.00485	0.0306	0.0114	0.0778	< 0.00459	< 0.00999	0.0413	0.00595 J	0.00449 UJ	0.00457 UJ
	Benzo(a)pyrene	8270 SIM	0.02	mg/kg dry	<0.0048	<0.00452	< 0.00487	0.0073	0.00512	0.0146	< 0.00848	0.00497	0.0139	0.0129	**0.0413**	< 0.00459	0.0133	0.0171	< 0.00487	0.00449 UJ	0.00457 UJ
	Benzo(b)fluoranthene	8270 SIM	0.15	mg/kg dry	<0.0048	<0.00452	< 0.00487	0.0102	0.0138	< 0.0109	< 0.00848	0.00646	< 0.00519	0.0324	0.0471	< 0.00459	0.0257	< 0.0106	< 0.00487	0.00449 UJ	0.00457 UJ
	Benzo(k)fluoranthene	8270 SIM	1.5	mg/kg dry	<0.0048	<0.00452	< 0.00487	< 0.00476	< 0.00461	< 0.0109	< 0.00848	< 0.00485	0.0208	< 0.00429	< 0.00865	< 0.00459	< 0.00999	< 0.0106	< 0.00487	0.00449 UJ	0.00457 UJ
	Chrysene	8270 SIM	15	mg/kg dry	<0.0048	<0.00452	< 0.00487	0.0063	0.0102	0.0839	< 0.00848	0.00895	0.0491	0.0100	0.1960	< 0.00459	0.0114	0.0816	0.0146 J	0.00449 UJ	0.00457 UJ
	Dibenzo(a,h)anthracene	8270 SIM	0.02	mg/kg dry	<0.0048	<0.00452	< 0.00487	0.0093	< 0.00461	< 0.0109	< 0.00848	< 0.00485	0.0081	0.0048	< 0.00865	< 0.00459	< 0.00999	< 0.0106	< 0.00487	0.00449 UJ	0.00457 UJ
	Indeno(1,2,3-cd)pyrene	8270 SIM	0.15	mg/kg dry	<0.0048	<0.00452	< 0.00487	0.0083	< 0.00461	0.0109	< 0.00848	< 0.00485	0.0075	0.0067	0.0087	< 0.00459	0.0124	< 0.0106	< 0.00487	0.00449 UJ	0.00457 UJ
Non- Carcinogenic PAH	Acenaphthene	8270 SIM	52.3	mg/kg dry	<0.0048	<0.00452	0.00584	< 0.00476	< 0.00461	0.3680	< 0.00848	< 0.00485	0.0381	< 0.00429	0.1680	< 0.00459	< 0.00999	0.347 J	0.0271 J	0.00449 UJ	0.00457 UJ
	Acenaphthylene	8270 SIM	78	mg/kg dry	<0.0048	<0.00452	< 0.00487	< 0.00476	< 0.00461	< 0.0109	< 0.00848	< 0.00485	< 0.00519	< 0.00429	< 0.00865	< 0.00459	< 0.00999	0.0106 UJ	< 0.00487	0.00449 UJ	0.00457 UJ
	Anthracene	8270 SIM	1040	mg/kg dry	<0.0048	<0.00452	< 0.00487	< 0.00476	< 0.00461	< 0.0109	< 0.00848	< 0.00485	0.1080	< 0.00429	0.6150	< 0.00459	< 0.00999	0.315 J	0.0173 J	0.00499 J	0.00457 UJ
	Benzo(g,h,i)perylene	8270 SIM	1178	mg/kg dry	<0.0048	<0.00452	< 0.00487	0.0107	0.00563	0.0243	0.0160	0.00597	0.0098	0.0091	0.0211	< 0.00459	0.0200	0.0151	0.00487 J	0.00449 UJ	0.00457 UJ
	Fluoranthene	8270 SIM	364	mg/kg dry	<0.0048	<0.00452	< 0.00487	< 0.00476	0.00922	0.0511	< 0.00848	0.00994	0.0294	0.0076	0.1530	< 0.00459	< 0.00999	0.0826	0.0146 J	0.00449 UJ	0.00457 UJ
	Fluorene	8270 SIM	54.8	mg/kg dry	<0.0048	<0.00452	< 0.00487	< 0.00476	< 0.00461	0.5120	< 0.00848	< 0.00485	0.0531	< 0.00429	0.2800	< 0.00459	< 0.00999	0.545	0.0401 J	0.00499 J	0.00457 UJ
	Naphthalene	8270 SIM	1.14	mg/kg dry	<0.0048	<0.00452	0.00908	< 0.00476	0.00768	0.2600	< 0.00848	< 0.00485	< 0.00519	< 0.00429	< 0.00865	< 0.00459	< 0.00999	0.504	0.0541 J	0.00449 UJ	0.00457 UJ
	Phenanthrene	8270 SIM	79	mg/kg dry	<0.0048	<0.00452	< 0.00487	< 0.00476	0.00973	0.7860	< 0.00848	0.0104	0.2310	< 0.00429	1.6400	0.000501	< 0.00999	0.802	0.0487 J	0.00449 UJ	0.00457 UJ
	Pyrene	8270 SIM	359	mg/kg dry	<0.0048	<0.00452	< 0.00487	< 0.00476	0.0164	0.4400	< 0.00848	0.00994	0.1070	0.0224	0.1460	< 0.00459	0.0238	0.494	0.0514 J	0.00449 UJ	0.00457 UJ
	1-Methylnaphthalene	8270 SIM	22	mg/kg dry	<0.0048	<0.00452	0.0279	< 0.00476	0.00973	0.8110	< 0.00848	0.00547	0.1490	< 0.00429	1.7400	< 0.00459	< 0.00999	4.04	0.0769 J	0.00449 UJ	0.00457 UJ
	2-Methylnaphthalene	8270 SIM	310	mg/kg dry	<0.0048	<0.00452	0.00779	< 0.00476	0.0159	0.5700	< 0.00848	0.00795	0.0358	< 0.00429	1.6000	< 0.00459	< 0.00999	5.21	0.0628 J	0.00449 UJ	0.00457 UJ

Notes:

Bold - Detection is above media Screening Levels
NSA - No screening level available.
" < " - The analyte is not detected above the reporting quantitation limit.
U - Analyte not detected above the reported amount as a result of validation rules.
J - The analyte is positively idenitifed. However, the result is an estimated value.
UJ - The analyte was not detected above the reporting quantitation limit. However the reporting limit is approximate.
R - The data is rejected due to a deficiency in quality control criteria.

TABLE 3-3
Monitoring Well Construction Details

Well ID	Well Type	Casing Diameter	Casing Construction	Measuring Point	Measuring Point Elevation (Feet amsl)	Depth to Bottom of Well (Feet BMP)	Top of Screen Interval (Feet BGS)	Top of Screen Elevation (Feet amsl)	Bottom of Screen Interval (Feet BGS)	Bottom of Screen Elevation (Feet amsl)
Monitoring Wells										
GA-1	Flush Mount	2-inch	PVC	Top of casing.	2478.19	21	6	2472.19	21	2457.19
GA-2	Flush Mount	2-inch	PVC	Top of casing.	2472.74	20.1	5.1	2467.64	20.1	2452.64
GA-3	Flush Mount	2-inch	PVC	Top of casing.	2479.23	26.5	11.5	2467.73	26.5	2452.73
GA-4	Flush Mount	2-inch	PVC	Top of casing.	2474.21	21	6	2468.21	21	2453.21
EMW-01	Flush Mount	2-inch	PVC	Top of casing.	2478	12.6	2.5	2475.50	12.6	2465.4
EMW-02	Flush Mount	2-inch	PVC	Top of casing.	2477.82	16	6	2471.82	16	2461.82
EMW-03	Flush Mount	2-inch	PVC	Top of casing.	2478.1	19	9	2469.10	19	2459.1
EMW-04	Flush Mount	2-inch	PVC	Top of casing.	2478.33	17	7.0	2471.33	17	2461.33
EMW-05	Flush Mount	2-inch	PVC	Top of casing.	2480.24	19.5	9.5	2470.74	19.5	2460.74
EMW-06	Flush Mount	2-inch	PVC	Top of casing.	**2479.36**	18.5	8.5	2470.86	18.5	2460.86
EW-3	Stick-up	3-foot	Currogated Metal	Top of casing/monument.	2478	15.75				
EW-4	Stick-up	3-foot	Currogated Metal	Top of casing/monument.	2479.43	15.5				
EW-?	Stick-up	3-foot	Currogated Metal	Top of casing/monument.	2483.43					
MW-5	Flush Mount	2-inch	PVC	Top of casing.	2478.06	12.9				
MW-11	Stick-up	2-inch	PVC	Top of casing.	2484.28	~22				
HC-4	Flush Mount	4-inch	PVC	Top of casing.	2483.01	15.93	9.25	2473.76	18.5	2464.51
HC-1R	Flush Mount	2-inch	PVC	Top of casing.	2477.81	18	9	2468.81	18	2459.81
DW-01	Stick-up	6-inch	Steel.	Top of casing.	2475.91	~68				
Stick-Up Pipes										
#1010	Stick-up	4-inch	PVC	Top of casing	2481.82	15.34				
#1002	Stick-up	4-inch	PVC	Top of casing	2482.21	14.9				
#1006	Stick-up	1.5-inch	PVC	Top of casing	2484.63	23.05				
#1005	Stick-up	4-inch	PVC	Top of casing	2483.13	17.1				
#1007	Stick-up	4-inch	PVC	Top of casing	2481.56	15.2				
#1014	Stick-up	4-inch	PVC	Top of casing	2485.18	20.85				
#1015	Stick-up	2-inch	PVC	Top of cap	2485.23	---				
Black Pipe	Stick-up	2-inch	PVC	Top of cap	2483.58	---				
#1030	Stick-up	4-inch	PVC	Top of casing	2482.69	17.43				
#1031	Stick-up	4-inch	PVC	Top of casing	2482.63	18				
#1025	Stick-up	4-inch	PVC	Top of casing	2483.31	19.12				
#1024	Stick-up	4-inch	PVC	Top of casing	2482.98	16.78				
#1023	Stick-up	4-inch	PVC	Top of casing	2483.89	16.94				
#1012	Stick-up	4-inch	PVC	Top of casing.	2483.01	15.93				
Piezometer	Stick-up	3/4-inch	PVC.	Top of casing.	2484.16	9.5	N/A		N/A	N/A

Note: **Bold** - Surveyor indicated TOC elevation for EMW-06 required +3.73 foot correction.

TABLE 3-4a
Groundwater Level Measurements - September 2009

ID	Time	Date	Water Level (Feet BTOC)	TOC Elevation (Feet AMSL)	Water Elevation (Feet AMSL)	LNAPL Level (Feet BTOC)	LNAPL Thickness (Feet)	LNAPL Corrected Water Level	Odor/Sheen
Monitoring Wells									
GA-1	10:04	9/1/2009	13.6	2478.19	2464.59	13.59	0.01	2464.60	Probe coated in oil like product.
GA-2	9:35	9/1/2009	8.62	2472.74	2464.12	---	---		
GA-3	9:45	9/1/2009	15.92	2479.23	2463.31	---	---		
GA-4	9:24	9/1/2009	9.81	2474.21	2464.40	---	---		
EMW-01	12:43	9/1/2009	10.2	2478.00	2467.80	---	---		
EMW-02	15:01	9/1/2009	10.81	2477.82	2467.01	---	---		Slight odor.
EMW-03	10:31	9/1/2009	13.32	2478.10	2464.78	---	---		
EMW-04	10:46	9/1/2009	13.63	2478.33	2464.70	---	Thin Layer		Probe coated in oil like product.
EMW-05	11:02	9/1/2009	14.68	2480.24	2465.56	---	---		
EMW-06	12:09	9/1/2009	13.89	**2479.36**	2465.47	13.65	0.24	2465.69	Probe coated in oil and diesel like product.
EW-3	13:39	9/1/2009	12.18	2478.00	2465.82	---	---		
EW-4	13:46	9/1/2009	12.85	2479.43	2466.58	---	---		Sheen on water.
MW-5	12:54	9/1/2009	10.99	2478.06	2467.07	---	---		
MW-11	11:45	9/1/2009	N/A	2484.28	---	17.3			Probe coated in oil like product.
HC-4	---	---	NS	NS	---	---	---		
HC-1R	14:38	9/1/2009	13.23	2477.81	2464.58	---	---		
DW-01	9:54	9/1/2009	11.54	2475.91	2464.37	---	---		
EW-?	16:33	9/4/2009	18.05	2483.43	2465.38	---	---		
Stick-up Pipes									
#1002	10:10	9/9/2009	Dry	2482.21	---	---	---		
#1005	10:07	9/9/2009	16.55	2483.13	2466.58	---	---		
#1006	10:00	9/9/2009	18.1	2484.63	2466.53	---	---		Probe smells like petroleum.
#1007	9:56	9/9/2009	14.7	2481.56	2466.86	---	---		
#1010	16:46	9/4/2009	Dry	2481.82	---	15.34	Thin Layer		Oil like product at bottom of well.
#1012	14:00	9/1/2009	Dry	2483.01	---	---	---		
#1014	16:41	9/4/2009	19.55	2485.18	2465.63	---	---		
#1015	16:43	9/4/2009	Dry	2485.23	---	---	---		
#1023	16:25	9/4/2009	Dry	2483.89	---	---	---		
#1024	16:23	9/4/2009	Dry	2482.98	---	---	---		
#1025	16:19	9/4/2009	18.29	2483.31	2465.02	---	---		
#1030	16:16	9/4/2009	Dry	2482.69	---	---	---		
#1031	16:12	9/4/2009	17.43	2482.63	2465.20	---	---		
Black Pipe	16:30	9/4/2009	N/A	2483.58	---	---	---		
Piezometer	15:49	9/1/2009	Dry	2484.16	---	---	---		

Notes:

Dry - At the time of measurement, the well did not contain any water.

N/A - Water level not measured in this well due to extenuating circumstances.

NS - could not be located in September 2009 so it was not included in the geodetic survey.

* Could not determine LNAPL thickness due to presence of drop tube in well.

LNAPL Corrected Water Level Calculation = Water Level + (LNAPL thickness x 0.90 specific gravity of LNAPL)

Bold - Surveyor indicated TOC elevation for EMW-06 required +3.73 foot correction.

TABLE 3-4b
Groundwater Level Measurements - November 2009

ID	Time	Date	Water Level (Feet BTOC)	TOC Elevation (Feet AMSL)	Water Elevation (Feet AMSL)	LNAPL Level (Feet BTOC)	LNAPL Thickness (Feet)	LNAPL Corrected Water Level	Odor/Sheen
Monitoring Wells									
GA-1	13:00	11/19/2009	13.72	2478.19	2464.47	---	---		
GA-2	7:45	11/19/2009	8.77	2472.74	2463.97	---	---		
GA-3	8:00	11/19/2009	16.07	2479.23	2463.16	---	---		
GA-4	7:32	11/19/2009	9.94	2474.21	2464.27	---	---		
EMW-01	8:15	11/19/2009	10.31	2478.00	2467.69	---	---		
EMW-02	11:45	11/19/2009	10.84	2477.82	2466.98	---	---		
EMW-03	11:40	11/19/2009	13.43	2478.10	2464.67	---	---		
EMW-04	12:00	11/19/2009	13.66	2478.33	2464.67	*	---		
EMW-05	13:05	11/19/2009	14.81	2480.24	2465.43	---	---		
EMW-06	12:40	11/19/2009	13.63	**2479.36**	2465.73	*	---		
EW-3	15:40	11/19/2009	12.13	2478.00	2465.87	---	---		
EW-4	14:42	11/19/2009	12.81	2479.43	2466.62	---	---		
MW-5	12:35	11/19/2009	11.70	2478.06	2466.36	---	---		
MW-11	9:20	11/19/2009	---	2484.28	---	---	3.73 (ft from bottom of well)		
HC-4	8:30	11/19/2009	14.44	NS	---	13.20	1.24		
HC-1R	15:20	11/19/2009	13.35	2477.81	2464.46	---	---		
DW-01	10:50	11/19/2009	11.62	2475.91	2464.29	---	---		
Stick-up Pipes									
#1007	15:35	11/19/2009	14.68	2481.56	2466.88	---	---		Slight petroleum-like odor noted.
#1010	11:25	11/19/2009	---	2481.82	---	15.95	---		Could not determine depth to water due to presence of viscous oil.
Piezometer	15:50	11/19/2009	dry	2484.16	---	---	---		

Notes: * Could not determine LNAPL thickness due to presence of drop tube in well.

NS - could not be located in September 2009 so it was not included in the geodetic survey.

LNAPL Corrected Water Level Calculation = Water Level + (LNAPL thickness x specific gravity of LNAPL)

Bold - Surveyor indicated TOC elevation for EMW-06 required +3.73 foot correction.

TABLE 3-5
Water Quality Parameters

Sample Location ID	Date	Time	pH	Temperature (°C)	Specific Conductivity (µS/cm)	Dissolved Oxygen (mg/L)	Turbidity (NTU)	Notes
Groundwater Samples								
GA-1	9/5/2009	9:21	6.67	10.7	348	0.04	1.73	Purge water had petroleum-like odor and a sheen.
GA-2	9/2/2009	12:01	6.98	11.4	167.9	0.09	4.69	
GA-3	9/3/2009	9:23	7.06	14	101.7	0.06	0.81	
GA-4	9/2/2009	14:20	6.74	11.6	201.9	1.96	1.75	
EMW-04	9/4/2009	15:25	6.69	11.9	285.6	0.06	0.76	Purge water had petroleum-like odor and a sheen.
EMW-05	9/5/2009	11:13	6.76	10.8	228.8	0.08	0.18	Purge water had medium strength petroleum-like odor.
EMW-06	9/5/2009	13:18	6.66	12.6	213	0.06	0.28	Purge water had slight petroleum-like odor and a sheen.
EW-3	9/4/2009	10:55	6.17	12.5	164.9	0.08	7.02	Turbidity fluctuated throughout duration of purge from 6.24 - 7.19 NTU.
EW-4	9/4/2009	13:07	6.28	13.7	163.9	0.06	4.45	
MW-5	9/2/2009							Not able to monitor water quality parameters due to limited water volume in well. Sample was turbid.
HC-1R	9/4/2009	8:50	6.45	10.3	287.8	0.06	3.51	Purge water had petroleum-like odor.
DW-01	9/2/2009	18:39	6.99	9.1	240.7	0.16	97	Turbidity consistent around 100 NTU for 40 minutes.
Surface Water Samples								
RS-1	9/6/2009	10:31	7.68	12.5	61.8	9.64	0.74	
RS-2	9/6/2009	10:45	7.33	14.3	58.7	9.75	0.46	
RS-3	9/6/2009	11:30	7.79	15	69.8	9.92	0.54	
RS-4	9/6/2009	13:19	7.35	14.7	75.3	8.48	4.52	
RS-5	9/6/2009	13:57	7.15		85.2	8.65	1.32	
RS-6	9/6/2009	14:46	7.04	15.9	83.8	8.00		
RS-7	9/6/2009	15:20	7.45	16.7	80.8	7.04	1.32	
RS-8	9/6/2009	16:19	7.67	16.3	16.9	8.33	1.32	

TABLE 3-6
Groundwater Results

Type	Analytes	Method	Screening Level ug/L	Idaho Surface Water Standards* ug/L	Sample ID	G-GA1-090509	G-GA1-090509	G-GA2-090209	G-GA3-090309	G-GA3-090309	G-GA4-090209	G-GA4-090209	G-DW01-090209	G-DW01-090209	G-MW5-090309	G-HC1R 090409	G-EW3-090409	G-EW3-090409	G-EW4-090409	G-EWM04-090409	G-EWM04-090409	G-EWM05-090509	G-EMW05-090509	G-EMW06-090509	G-EMW06-090509
					Collection Date	09/05/09	09/05/09	9/2/2009	9/3/2009	9/3/2009	9/2/2009	9/2/2009	9/2/2009	9/2/2009	9/3/2009	9/4/2009	9/4/2009	9/4/2009	9/4/2009	9/4/2009	9/4/2009	9/4/2009	09/05/09	09/05/09	9/5/2009	9/5/2009
					Units																				
TPH	Diesel Range Organics	NWTPH-Dx	NSA	NSA	ug/L	352 J	---	< 243	< 243	---	< 243	---	< 243	---	484	992	1850	---	< 236	< 236	---	611	---	546	---
	Heavy Oils	NWTPH-Dx	NSA	NSA	ug/L	472 UJ	---	< 485	< 485	---	< 485	---	< 485	---	713	637	1600	---	< 472	< 472	---	< 472	---	< 481	---
PCBs	Aroclor 1016	8082	0.5	0.000064	ug/L	0.047 UJ	---	< 0.047	< 0.047	---	< 0.047	---	N/A	---	N/A	N/A	N/A	---	N/A	N/A	---	N/A	---	N/A	---
	Aroclor 1221	8082	0.0068	0.000064	ug/L	0.047 UJ	---	0.047 UJ	0.047 UJ	---	0.047 UJ	---	N/A	---	N/A	N/A	N/A	---	N/A	N/A	---	N/A	---	N/A	---
	Aroclor 1232	8082	0.0068	0.000064	ug/L	0.047 UJ	---	0.047 UJ	0.047 UJ	---	0.047 UJ	---	N/A	---	N/A	N/A	N/A	---	N/A	N/A	---	N/A	---	N/A	---
	Aroclor 1242	8082	0.028	0.000064	ug/L	0.047 UJ	---	0.047 UJ	0.047 UJ	---	0.047 UJ	---	N/A	---	N/A	N/A	N/A	---	N/A	N/A	---	N/A	---	N/A	---
	Aroclor 1248	8082	0.028	0.000064	ug/L	0.047 UJ	---	0.047 UJ	0.047 UJ	---	0.047 UJ	---	N/A	---	N/A	N/A	N/A	---	N/A	N/A	---	N/A	---	N/A	---
	Aroclor 1254	8082	0.034	0.000064	ug/L	0.047 UJ	---	0.047 UJ	0.047 UJ	---	0.047 UJ	---	N/A	---	N/A	N/A	N/A	---	N/A	N/A	---	N/A	---	N/A	---
	Aroclor 1260	8082	0.028	0.000064	ug/L	0.047 UJ	---	< 0.047	< 0.047	---	< 0.047	---	N/A	---	N/A	N/A	N/A	---	N/A	N/A	---	N/A	---	N/A	---
Carcinogenic PAH	Benzo(a)anthracene	8270 SIM	0.029	0.0038	ug/L	0.0024 J	---	< 0.0094	< 0.0094	---	< 0.0094	---	< 0.0094	---	**0.0081 J**	< 0.0094	< 0.0094	---	< 0.0094	< 0.0094	---	< 0.0096	---	**0.0040 J**	---
	Benzo(a)pyrene	8270 SIM	0.0029	0.0038	ug/L	< 0.019	---	< 0.019	< 0.019	---	< 0.019	---	< 0.019	---	< 0.019	< 0.019	< 0.019	---	< 0.019	< 0.019	---	< 0.019	---	< 0.019	---
	Benzo(b)fluoranthene	8270 SIM	0.029	0.0038	ug/L	< 0.0094	---	< 0.0094	< 0.0094	---	< 0.0094	---	< 0.0094	---	< 0.0095	< 0.0094	< 0.0094	---	< 0.0094	< 0.0094	---	< 0.0096	---	< 0.0094	---
	Benzo(k)fluoranthene	8270 SIM	0.29	0.0038	ug/L	< 0.0094	---	< 0.0094	< 0.0094	---	< 0.0094	---	< 0.0094	---	< 0.0095	< 0.0094	< 0.0094	---	< 0.0094	< 0.0094	---	< 0.0096	---	< 0.0094	---
	Chrysene	8270 SIM	2.9	0.0038	ug/L	**0.0065 J**	---	< 0.0094	< 0.0094	---	< 0.0094	---	< 0.0094	---	**0.011**	< 0.0094	0.0023 J	---	< 0.0094	**0.0052 J**	---	0.0024 J	---	**0.0068 J**	---
	Dibenzo(a,h)anthracene	8270 SIM	0.0029	0.0038	ug/L	< 0.0094	---	< 0.0094	< 0.0094	---	< 0.0094	---	< 0.0094	---	< 0.0095	< 0.0094	< 0.0094	---	< 0.0094	< 0.0094	---	< 0.0096	---	< 0.0094	---
	Indeno(1,2,3-cd)pyrene	8270 SIM	0.029	0.0038	ug/L	< 0.0094	---	< 0.0094	< 0.0094	---	< 0.0094	---	< 0.0094	---	< 0.0095	< 0.0094	< 0.0094	---	< 0.0094	< 0.0094	---	< 0.0096	---	< 0.0094	---
Non- Carcinogenic PAH	Acenaphthene	8270 SIM	626	670	ug/L	0.20	---	0.0029 J	0.025	---	< 0.0094	---	0.0011 J	---	0.5	0.21	0.040	---	0.0094 U	0.049	---	1.0	---	1.6	---
	Acenaphthylene	8270 SIM	626	NSA	ug/L	0.042	---	< 0.0094	0.0050 J	---	0.0016 J	---	< 0.0094	---	0.081	0.027	0.0055 J	---	< 0.0094	0.0073 J	---	0.13	---	0.25	---
	Anthracene	8270 SIM	3,129	8,300	ug/L	0.033	---	0.0021 J	< 0.0094	---	0.00083 J	---	0.0016 J	---	0.088	0.036	0.0096	---	0.0094 U	0.017	---	0.19	---	0.26	---
	Benzo(g,h,i)perylene	8270 SIM	313	NSA	ug/L	< 0.0094	---	< 0.0094	< 0.0094	---	< 0.0094	---	< 0.0094	---	0.0021 J	< 0.0094	< 0.0094	---	< 0.0094	< 0.0094	---	< 0.0096	---	< 0.0094	---
	Fluoranthene	8270 SIM	417	130	ug/L	0.018	---	0.0032 J	0.0087 J	---	< 0.0094	---	< 0.0094	---	0.023	0.0094 U	0.014	---	0.0094 U	0.0094 U	---	0.048	---	0.060	---
	Fluorene	8270 SIM	417	1,100	ug/L	0.47	---	0.0034 J	0.019	---	0.0020 J	---	0.0012 J	---	0.47	0.12	0.054	---	0.0094 U	0.078	---	1.3	---	2.3	---
	Naphthalene	8270 SIM	0.14	NSA	ug/L	0.039	---	0.0062 J	0.040	---	0.0074 J	---	< 0.0094	---	**0.22**	0.078	0.017	---	0.0094 U	0.042	---	**2.4**	---	**5.8**	---
	Phenanthrene	8270 SIM	313	NSA	ug/L	0.040	---	0.0094 U	0.020	---	0.0094 U	---	0.0094 U	---	0.14	0.0099	0.036	---	0.0094 U	0.014	---	1.3	---	2.0	---
	Pyrene	8270 SIM	313	830	ug/L	0.019	---	0.0094 U	0.0097 U	---	0.0094 U	---	< 0.0094	---	0.064	0.014	0.033	---	0.0094 U	0.015	---	0.055	---	0.074	---
	1-Methylnaphthalene	8270 SIM	0.14	NSA	ug/L	0.077	---	0.0094 U	0.021	---	0.0094 U	---	0.0094 U	---	**1.1**	0.069	0.045	---	0.0094 U	0.034	---	**9.7**	---	**14**	---
	2-Methylnaphthalene	8270 SIM	150	NSA	ug/L	< 0.012	---	0.0037	0.020	---	0.0048 J	---	< 0.012	---	0.094	0.012	0.012 U	---	< 0.012	0.066	---	1.6	---	6.7	---
Total Metals	Aluminum	6010 / 6020	200	NSA	ug/L	< 500	---	400 U	400 U	---	71 J	---	400 U	---	**3700**	< 500	< 500	12	< 500	< 500	14	< 500	12	< 500	20
	Arsenic	6010 / 6020	50	50*	ug/L	**6.3**	**9.6**	< 2.0	**0.91 J**	**---**	< 2.0	---	< 2.0	---	**10**	< 2.0	**37**	<2.0	< 2.0	**15**	**17**	**52**	**63**	**23**	**28**
	Antimony	6010 / 6020	6	5.6	ug/L	0.78 J	---	< 2.0	1.5 J	---	2.8	---	1.8 J	---	1.5 J	1.4 J	0.95 J	0.9	0.74 J	0.62 J	2.2	< 2.0	1.9	< 2.0	1.8
	Barium	6010 / 6020	2000	NSA	ug/L	94	---	77	38	---	25	---	19	---	55	8.1	97	25	23	62	61	57	59	45	44
	Beryllium	6010 / 6020	4	NSA	ug/L	< 2.0	---	< 2.0	< 2.0	---	< 2.0	---	< 2.0	---	< 2.0	< 2.0	< 2.0	<2.0	< 2.0	< 2.0	<2.0	< 2.0	<2.0	< 2.0	<2.0
	Calcium	6010 / 6020	NSA	NSA	ug/L	70000	---	27000	21000	---	34000	---	38000	---	24000	12000	61000	29000	29000	69000	69000	34000	35000	36000	34000
	Cadmium	6010 / 6020	5	0.6	ug/L	< 2.0	---	< 2.0	< 2.0	---	< 2.0	---	< 2.0	---	< 2.0	< 2.0	< 2.0	<2.0	< 2.0	< 2.0	<2.0	< 2.0	<2.0	< 2.0	<2.0
	Chromium	6010 / 6020	100	74	ug/L	< 2.0	---	0.71 J	0.38 J	---	0.62 J	---	< 2.0	---	4.3	0.52 J	< 2.0	0.6	< 2.0	< 2.0	0.7	< 2.0	0.8	< 2.0	1
	Cobalt	6010 / 6020	11	NSA	ug/L	1.2 J	---	0.7 J	0.38 J	---	1.3 J	---	< 2.0	---	3.2	< 2.0	1.1 J	0.82	0.45 J	0.6 J	1.7	0.42 J	1.4	< 2.0	1.3
	Copper	6010 / 6020	1000	11	ug/L	1.3 J	---	2.6 J	1.6 J	---	3.7 J	---	2 J	---	**18**	0.82 J	0.83 J	0.68	0.84 J	0.81 J	0.4	0.77 J	0.22	0.64 J	0.21
	Iron	6010 / 6020	300	NSA	ug/L	**7800**	**8000**	65 J	53 J	---	< 200	---	**8,800**	**1,100**	**10,000**	200	**38,000**	**5,100**	**2,300**	**20,000**	**19,000**	**19,000**	**19,000**	**12,000**	**11,000**
	Lead	6010 / 6020	15	2.5	ug/L	< 2.0	---	0.18 J	< 2.0	---	< 2.0	---	0.3 J	---	**12**	< 2.0	< 2.0	<2.0	< 2.0	< 2.0	<2.0	< 2.0	<2.0	< 2.0	<2.0
	Magnesium	6010 / 6020	NSA	NSA	ug/L	11000	---	6600	3300	---	9900	---	11000	---	8000	2500	8700	6400	8000	11000	11000	6900	6800	7800	7500
	Manganese	6010 / 6020	50	NSA	ug/L	**2000**	**---**	**250**	**440**	**470**	**180**	**180**	**220**	**---**	**1,400**	8.5 J	**3800**	**210**	**180**	**1,400**	**1,300**	**2,200**	**2,300**	**1,000**	**980**
	Mercury	7470A / 7471B	1	NSA	ug/L	< 0.2	---	< 0.02	< 0.02	---	< 0.02	---	< 0.02	---	0.073 J	< 0.2	< 0.2	<0.20	0.12 J	0.074 J	<0.20	0.079 J	<0.20	0.12 J	<0.20
	Nickel	6010 / 6020	209	52	ug/L	2.0 J	---	2.4	2.4	---	2.7	---	1.4 J	---	5.7	0.44 J	1.4 J	0.9	1.2 J	1.3 J	1.3	0.85 J	0.44	0.73 J	0.42
	Potassium	6010 / 6020	NSA	NSA	ug/L	3400	---	2300 J	2400 J	---	3200 J	---	1300 J	---	1600 J	740 J	2900 J	1100	900 J	3200 J	3200	1500 J	1600	1400 J	1400
	Selenium	6010 / 6020	50	5	ug/L	< 2.0	---	< 2.0	< 2.0	---	< 2.0	---	1 J	---	< 2.0	< 2.0	< 2.0	0.5	< 2.0	< 2.0	0.9	< 2.0	0.5	< 2.0	<2.0
	Silver	6010 / 6020	52	3.4	ug/L	< 2.0	---	< 2.0	< 2.0	---	< 2.0	---	< 2.0	---	< 2.0	< 2.0	< 2.0	<2.0	< 2.0	< 2.0	<2.0	< 2.0	<2.0	< 2.0	<2.0
	Sodium	6010 / 6020	NSA	NSA	ug/L	3500	---	2800 J+	2000 U	---	2800 J+	---	2400 J+	---	2700 J+	1100 J	2,400	2,200	2,500	3,300	3,200	2,400	2,300	2,600	2,600
	Thallium	6010 / 6020	2	0.24	ug/L	< 4.0	---	< 4.0	< 4.0	---	4 U	---	4 U	---	4.0 U	< 4.0	< 4.0	**0.5**	< 4.0	< 4.0	**1.4**	< 4.0	**1.1**	< 4.0	0.92
	Vanadium	6010 / 6020	180	NSA	ug/L	< 2.0	---	< 2.0	0.75 J	---	< 2.0	---	< 2.0	---	5.7	< 2.0	< 2.0	1.6	< 2.0	< 2.0	2.0	< 2.0	3.1	< 2.0	3.1
	Zinc	6010 / 6020	3129	120	ug/L	< 7.0	---	2.7 J	2.5 J	---	3.1 J	---	240	84	28	< 7.0	< 7.0	**32,000**	**1,200**	< 7.0	27.0	< 7.0	4.0	< 7.0	5.6

Notes:

Shading indicates dissolved metals analysis.

Bold - Detection is above either the Screening Level or the Idaho Surface Water Standards.

NSA - No screening level available.

N/A - This sample was not analyzed for this constituent.

" < " - The analyte is not detected above the reporting quantitation limit.

U - Analyte not detected above the reported amount as a result of validation rules.

J - The analyte is positively idenitifed. However, the result is an estimated value.

UJ - The analyte was not detected above the reporting quantitation limit. However the reporting limit is approximate.

R - The data is rejected due to a deficiency in quality control criteria.

* Adapted from the Idaho Water Quality Standards IDAPA 58.01.02. The lowest value for each constituent was referenced. Idaho will be adopting a 10 ug/L standard for arsenic in 2010.

TABLE 3-7
LNAPL Results

	Analytes	Method	Screening Level mg/kg	Sample ID / Collection Date / Units	G-MW11FP-090109 9/1/2009	G-P1010FP-090409 9/4/2009	G-HC4FP-111909 11/19/2009	G-RS5FP-090509 9/5/2009	G-RS4FP-090509 9/5/2009	G-RS3FP-090509 9/5/2009	G-RS3aFP-090509 9/5/2009
TPH (mg/Kg)	Diesel Range Organics	NWTPH-Dx	NSA	mg/kg	202000	201000	581000	233000	386000	154000	80700
	Heavy Oils	NWTPH-Dx	NSA	mg/kg	321000	120000	255000	265000	306000	149000	67500
PCBs (mg/Kg)	Aroclor 1016	8082	NSA	mg/kg	< 0.43	0.943 UJ	<1.0	0.962 UJ	0.980 UJ	0.877 UJ	< 2.38
	Aroclor 1221	8082	NSA	mg/kg	< 0.43	0.943 UJ	<1.0	0.962 UJ	0.980 UJ	0.877 UJ	< 2.38
	Aroclor 1232	8082	NSA	mg/kg	< 0.43	0.943 UJ	<1.0	0.962 UJ	0.980 UJ	0.877 UJ	< 2.38
	Aroclor 1242	8082	NSA	mg/kg	< 0.43	0.943 UJ	<1.0	0.962 UJ	0.980 UJ	0.877 UJ	< 2.38
	Aroclor 1248	8082	NSA	mg/kg	< 0.43	0.943 UJ	<1.0	0.962 UJ	0.980 UJ	0.877 UJ	< 2.38
	Aroclor 1254	8082	NSA	mg/kg	< 0.43	0.943 UJ	<1.0	0.962 UJ	0.980 UJ	0.877 UJ	< 2.38
	Aroclor 1260	8082	NSA	mg/kg	0.37 J	0.943 UJ	<1.0	0.962 UJ	0.980 UJ	0.877 UJ	< 2.38
Carcinogenic PAH	Benzo(a)anthracene	8270 SIM	NSA	mg/kg	40000	4.42	22.00	19.2 J	3.06 UJ	10.40	3.27
	Benzo(a)pyrene	8270 SIM	NSA	mg/kg	25000	4.62	<15	8.57	11.0 J	3.96	< 2.73
	Benzo(b)fluoranthene	8270 SIM	NSA	mg/kg	20000	2.88	<15	3.06	3.06 UJ	< 3.12	< 2.73
	Benzo(k)fluoranthene	8270 SIM	NSA	mg/kg	3000 J	2.88	<15	3.06	3.06 UJ	< 3.12	< 2.73
	Chrysene	8270 SIM	NSA	mg/kg	71000	9.04	30.00	45.7 J	50.6 J	23.1	7.27
	Dibenzo(a,h)anthracene	8270 SIM	NSA	mg/kg	< 32000	9.62	<15	4.29	4.90 J	< 3.12	2.73
	Indeno(1,2,3-cd)pyrene	8270 SIM	NSA	mg/kg	4700 J	10.2	<15	4.49	3.88 J	< 3.12	2.91
Non- Carcinogenic PAH (mg/Kg)	Acenaphthene	8270 SIM	NSA	mg/kg	42000	29.2	372	33.1	100	30.2	16.5
	Acenaphthylene	8270 SIM	NSA	mg/kg	< 16000	2.88	<15	3.06	3.06 UJ	< 3.12	< 2.73
	Anthracene	8270 SIM	NSA	mg/kg	26000	33.5	209	96.9	120	50.4	20.2
	Benzo(g,h,i)perylene	8270 SIM	NSA	mg/kg	6700 J	14.0	<15	9.59	12.2 J	3.12	3.64
	Fluoranthene	8270 SIM	NSA	mg/kg	69000	8.27	56	9.18	15.1	9.38	4.00
	Fluorene	8270 SIM	NSA	mg/kg	68000	45.6	316	86.3	178 J	45.6	25.3
	Naphthalene	8270 SIM	NSA	mg/kg	< 16000	13.3	252	3.06	3.06 UJ	7.29	6.91
	Phenanthrene	8270 SIM	NSA	mg/kg	140000	88.8	889	205	292	84.0	47.8
	Pyrene	8270 SIM	NSA	mg/kg	110000	22.7	128	118	161 J	55.8	15.3
	1-Methylnaphthalene	8270 SIM	NSA	mg/kg	52000	114	1350	15.3	328	63.1	47.6
	2-Methylnaphthalene	8270 SIM	NSA	mg/kg	16000 J	48.3	1870	3.06	35.3	< 3.12	45.6
Total Metals (mg/Kg)	Aluminum	6010 / 6020	NSA	mg/kg	110 UJ	1500	39	360	340	120 J	85 J
	Arsenic	6010 / 6020	NSA	mg/kg	2.2 J	4.8 J	2	4.6 J	4.4 J	1.7 J	1.2 J
	Antimony	6010 / 6020	NSA	mg/kg	< 11	< 12	<8.6	< 12	< 12	< 13	< 11
	Barium	6010 / 6020	NSA	mg/kg	2.4	24	1.5	7.4	5.9	3.4	2.2
	Beryllium	6010 / 6020	NSA	mg/kg	< 0.88	0.055 J	<0.72	< 1.0	< 0.97	< 1.1	< 0.93
	Calcium	6010 / 6020	NSA	mg/kg	43 J	570	21	470	340	340	280
	Cadmium	6010 / 6020	NSA	mg/kg	< 1.8	< 2	<1.4	< 2	< 1.9	< 2.2	< 1.9
	Chromium	6010 / 6020	NSA	mg/kg	13 J	1.8 J	1.1	2.1 J	2.0 J	0.47 J	< 4.8
	Cobalt	6010 / 6020	NSA	mg/kg	0.48 J	1.8 J	0.13	0.65 J	0.56 J	0.28 J	< 1.9
	Copper	6010 / 6020	NSA	mg/kg	38 J	12	2.2	69	71	12	4.6
	Iron	6010 / 6020	NSA	mg/kg	120 J	2300	42	390	170	57	130
	Lead	6010 / 6020	NSA	mg/kg	15	3.2 J	<4.3	24	27	< 6.7	< 5.6
	Magnesium	6010 / 6020	NSA	mg/kg	190 U	800	6.7	220 U	210 U	250 U	200 U
	Manganese	6010 / 6020	NSA	mg/kg	1.6 J	31	0.78	8.7	2.9 J	1.4 J	1.2 J
	Mercury	7470A /	NSA	mg/kg	0.018	< 0.036	<0.018	0.034 J	0.034 J	0.019 J	0.013 J
	Nickel	6010 / 6020	NSA	mg/kg	31 J	9.7	11	39	34	20	4.6
	Potassium	6010 / 6020	NSA	mg/kg	580 UJ	290 J	<480	180 J	< 640	< 740	< 610
	Selenium	6010 / 6020	NSA	mg/kg	< 18	< 20	<14	1.6 J	0.63 J	< 22	< 19
	Silver	6010 / 6020	NSA	mg/kg	< 3.5	< 4	<2.9	< 4.1	< 3.9	< 4.5	< 3.7
	Sodium	6010 / 6020	NSA	mg/kg	< 350	780 J	<290	850	970	1100	1100
	Thallium	6010 / 6020	NSA	mg/kg	18 U	< 20	<14	< 20	< 19	< 22	< 19
	Vanadium	6010 / 6020	NSA	mg/kg	26 J	8.5	15	110	140	16	4.1
	Zinc	6010 / 6020	NSA	mg/kg	6.9 J	21	<7.2	67	15	12	5.6 J

Notes:

Bold - Detection is above media Screening Levels
NSA - No screening level available.
" < " - The analyte is not detected above the reporting quantitation limit.
U - Analyte not detected above the reported amount as a result of validation rules.
J - The analyte is positively idenitifed. However, the result is an estimated value.
UJ - The analyte was not detected above the reporting quantitation limit. However the reporting limit is approximate.
R - The data is rejected due to a deficiency in quality control criteria.

TABLE 3-8
Hydraulic Test Measurements

Well ID	Well Depth (ft)	Depth to Water (ft)	Saturated Aquifer Thickness (ft)	Hydraulic Conductivities			
				Slug "In" (ft/day)		Slug "Out" (ft/day)	
				Hvorslev	Bouwer-Rice	Hvorslev	Bouwer-Rice
EMW-01	12.6	10.25	2.35	0.64	0.31		
EMW-02	16	10.92	5.08	1.74	1.13		
EMW-05	19.5	14.8	4.7	0.85	0.52		
HC-1R	18	13.33	4.67	5.16			
GA-2	20.1	8.62	11.48	3.59	2.53	0.82	0.60
GA-3	26.5	15.96	10.54	1.56	1.12	2.72	2.00
GA-4	21	9.87	11.13	3.13	2.25		

Note: Saturated aquifer thickness determined by subtracting water depth from well depth.

TABLE 3-9
Near Shore Sediment Results

Type	Analytes	Method	Screening Level mg/Kg	Sample ID	G-RS1SED-0-090709	G-RS1SED-4-090709	G-RS2SED-0-090709	G-RS2SED-3-090709	G-RS3SED-0-090709	G-RS3SED-4-090709	G-RS4SED-0-090709	G-RS4SED-4-090709	G-RS-5SED-0-090809	G-RS5SED-4-090709	G-RS6SED-0-090709	G-RS6SED-3-090709	G-RS7SED-0-090709	G-RS7SED-4-090709	G-RS8SED-0-090709	G-RS8SED-3-090709
				Collection Date	9/7/2009	9/7/2009	9/7/2009	9/7/2009	9/7/2009	9/7/2009	9/7/2009	9/7/2009	9/8/2009	9/7/2009	9/7/2009	9/7/2009	9/7/2009	9/7/2009	9/7/2009	9/7/2009
				Units																
TPH	Diesel Range Organics	NWTPH-Dx	NSA	mg/kg dry	ND	66.3	74.3	62.4	194	403	8830	39.6	24.3	73.1	22.4	25.3	< 14.9	< 11.8	< 14.7	< 12.5
	Heavy Oils	NWTPH-Dx	NSA	mg/kg dry	89	464	336	272	492	588	6980	164	112	178	140	126	< 37.3	< 29.6	< 36.7	< 31.3
PCBs	Aroclor 1016	8082	0.026	mg/kg dry	0.0097 U	0.0097 U	0.0098 U	0.0096 U	<0.0096	< 0.010	<0.0097	<0.0096	<0.010	< 0.010	<0.010	< 0.0098	0.0095 U	0.0099 U	0.0099 U	0.0095 U
	Aroclor 1221	8082	0.026	mg/kg dry	0.0097 U	0.0097 U	0.0098 U	0.0096 U	<0.0096	< 0.010	<0.0097	<0.0096	<0.010	< 0.010	<0.010	< 0.0098	0.0095 U	0.0099 U	0.0099 U	0.0095 U
	Aroclor 1232	8082	0.026	mg/kg dry	0.0097 U	0.0097 U	0.0098 U	0.0096 U	<0.0096	< 0.010	<0.0097	<0.0096	<0.010	< 0.010	<0.010	< 0.0098	0.0095 U	0.0099 U	0.0099 U	0.0095 U
	Aroclor 1242	8082	0.026	mg/kg dry	0.0097 U	0.0097 U	0.0098 U	0.0096 U	<0.0096	< 0.010	<0.0097	<0.0096	<0.010	< 0.010	<0.010	< 0.0098	0.0095 U	0.0099 U	0.0099 U	0.0095 U
	Aroclor 1248	8082	0.026	mg/kg dry	0.0097 U	0.0097 U	0.0098 U	0.0096 U	<0.0096	< 0.010	<0.0097	<0.0096	<0.010	< 0.010	<0.010	< 0.0098	0.0095 U	0.0099 U	0.0099 U	0.0095 U
	Aroclor 1254	8082	0.026	mg/kg dry	0.0097 U	0.0097 U	0.0098 U	0.0096 U	<0.0096	< 0.010	<0.0097	<0.0096	<0.010	< 0.010	<0.010	< 0.0098	0.0095 U	0.0099 U	0.0099 U	0.0095 U
	Aroclor 1260	8082	0.026	mg/kg dry	0.0097 U	0.01	0.0098 U	0.0096 U	<0.0096	< 0.010	<0.0097	<0.0096	<0.010	< 0.010	<0.010	< 0.0098	0.0095 U	0.0099 U	0.0099 U	0.0095 U
Carcinogenic PAH	Benzo(a)anthracene	8270 SIM	0.016	mg/kg dry	0.00494 UJ	0.0085 R	0.00498 UJ	0.00841 R	0.00471 R	**0.0709 J**	0.00947 R	< 0.00477	0.00586	**0.0326**	< 0.00462	< 0.00499	0.00497 UJ	0.00473 UJ	0.00489 UJ	0.00417 UJ
	Benzo(a)pyrene	8270 SIM	0.032	mg/kg dry	0.00494 UJ	0.0085 R	0.00498 UJ	0.00841 R	0.0101 J	**0.0333 J**	**0.0455 J**	< 0.00477	0.00521	**0.0774**	< 0.00462	0.00499 R	0.00497 UJ	0.00473 UJ	0.00489 UJ	0.00417 UJ
	Benzo(b)fluoranthene	8270 SIM	0.027	mg/kg dry	0.0155 J	0.0147 J	0.00498 UJ	0.00841 R	0.00471 R	**0.0388 J**	0.00947 R	< 0.00477	< 0.00488	**0.143**	< 0.00462	0.00499 R	0.0053 J	0.00473 UJ	0.00489 UJ	0.00417 UJ
	Benzo(k)fluoranthene	8270 SIM	0.027	mg/kg dry	0.00494 UJ	0.0085 R	0.00498 UJ	0.00841 R	0.00471 R	0.00831 R	**0.0467 J**	< 0.00477	0.01040	< 0.00498	< 0.00462	0.00499 R	0.00497 UJ	0.00473 UJ	0.00489 UJ	0.00417 UJ
	Chrysene	8270 SIM	0.027	mg/kg dry	0.00941 J	0.00907 J	0.00498 UJ	0.00841 R	0.0101 J	**0.129 J**	**0.0455 J**	< 0.00477	0.00976	**0.0625**	< 0.00462	< 0.00499	0.00497 UJ	0.00473 UJ	0.00489 UJ	0.00417 UJ
	Dibenzo(a,h)anthracene	8270 SIM	0.006	mg/kg dry	0.00494 UJ	**0.00907 J**	**0.00745 J**	**0.00897 J**	**0.0151 J**	**0.0111 J**	**0.0152 J**	**0.00796**	< 0.00488	**0.037**	< 0.00462	0.00499 R	0.00497 UJ	0.00473 UJ	0.00489 UJ	0.00417 UJ
	Indeno(1,2,3-cd)pyrene	8270 SIM	0.017	mg/kg dry	0.00494 UJ	0.0113 J	0.00881 J	0.00841 R	**0.0182 J**	0.0144 J	0.0114 J	0.00849	< 0.00488	**0.0746**	< 0.00462	0.00499 R	0.00497 UJ	0.00473 UJ	0.00489 UJ	0.00417 UJ
Non- Carcinogenic PAH	Acenaphthene	8270 SIM	0.0067	mg/kg dry	0.00494 UJ	0.0085 UJ	0.00498 UJ	0.00841 UJ	**0.0101**	**0.1030**	< 0.00947	< 0.00477	< 0.00488	**0.0453**	< 0.00462	< 0.00499	0.00497 UJ	0.00473 UJ	0.00489 UJ	0.00417 UJ
	Acenaphthylene	8270 SIM	0.0059	mg/kg dry	0.00494 UJ	0.0085 UJ	0.00498 UJ	0.00841 UJ	<0.00471	< 0.00831	< 0.00947	< 0.00477	< 0.00488	< 0.00498	< 0.00462	< 0.00499	0.00497 UJ	0.00473 UJ	0.00489 UJ	0.00417 UJ
	Anthracene	8270 SIM	0.01	mg/kg dry	0.00494 UJ	0.0085 UJ	0.00498 UJ	0.00841 UJ	0.00817	**0.1200**	< 0.00947	< 0.00477	< 0.00488	**0.0122**	< 0.00462	< 0.00499	0.00497 UJ	0.00473 UJ	0.00489 UJ	0.00417 UJ
	Benzo(g,h,i)perylene	8270 SIM	0.17	mg/kg dry	0.00672 J	0.0193 J	0.0115 J	0.0112 J	0.0277 J	0.0299 J	0.0101 J	0.0101	0.00586	0.106	< 0.00462	0.00499 R	0.00497 UJ	0.00473 UJ	0.00489 UJ	0.00417 UJ
	Fluoranthene	8270 SIM	0.031	mg/kg dry	0.00874 J	0.0085 UJ	0.00498 UJ	0.00841 UJ	<0.00471	**0.0521**	0.0189 J	< 0.00477	0.00716	0.0293	0.00616	< 0.00499	0.0139 J	0.00473 UJ	0.00489 UJ	0.00417 UJ
	Fluorene	8270 SIM	0.01	mg/kg dry	0.00494 UJ	0.0085 UJ	0.00498 UJ	0.00841 UJ	**0.0151**	**0.0998**	< 0.00947	< 0.00477	< 0.00488	**0.084**	< 0.00462	< 0.00499	0.00497 UJ	0.00473 UJ	0.00489 UJ	0.00417 UJ
	Naphthalene	8270 SIM	0.015	mg/kg dry	0.00494 UJ	0.0085 UJ	0.00498 UJ	0.00841 UJ	<0.00471	< 0.00831	< 0.00947	< 0.00477	< 0.00488	0.0122	< 0.00462	< 0.00499	0.00497 UJ	0.00473 UJ	0.00489 UJ	0.00417 UJ
	Phenanthrene	8270 SIM	0.019	mg/kg dry	0.00494 UJ	0.0085 UJ	0.00498 UJ	0.00841 UJ	**0.0214**	**0.3540**	**0.0202 J**	< 0.00477	< 0.00488	**0.0802**	< 0.00462	< 0.00499	0.00497 UJ	0.00473 UJ	0.00489 UJ	0.00417 UJ
	Pyrene	8270 SIM	0.044	mg/kg dry	0.0087	0.0204 J	0.00498 UJ	0.00841 R	0.027 J	**0.44 J**	**0.096 J**	0.00636	0.01430	**0.129**	0.00555	< 0.00499	0.0119 J	0.00473 UJ	0.00489 UJ	0.00417 UJ
	1-Methylnaphthalene	8270 SIM	NSA	mg/kg dry	0.00494 UJ	0.0085 UJ	0.00498 UJ	0.00841 UJ	0.0176	0.0964	< 0.00947	< 0.00477	< 0.00488	0.101	< 0.00462	< 0.00499	0.00497 UJ	0.00473 UJ	0.00489 UJ	0.00417 UJ
	2-Methylnaphthalene	8270 SIM	0.02	mg/kg dry	0.00494 UJ	0.0085 UJ	0.00498 UJ	0.00841 UJ	<0.00471	< 0.00831	< 0.00947	< 0.00477	< 0.00488	< 0.00498	< 0.00462	< 0.00499	0.00497 UJ	0.00473 UJ	0.00489 UJ	0.00417 UJ
Total Metals	Aluminum	6010 / 6020	25500	mg/kg dry	5300	4700	6700	4100	5100	5000	4600	3900	6900	5000	6900	6500	6900	3300	7000	5400
	Arsenic	6010 / 6020	5.9	mg/kg dry	5.8	**7.3**	**7.6**	**6.2**	**10**	**9.9**	**16**	**16**	**8.5**	**28**	**7.1**	**9.9**	**7**	**7.5**	**6.4**	5.4
	Antimony	6010 / 6020	2	mg/kg dry	1.3	**3.5**	1.9	**5.5**	**2.3**	1.3	**24**	1.1	1.2	**8.3**	0.85	0.93	0.68	**210**	0.64	0.75
	Barium	6010 / 6020	NSA	mg/kg dry	31	34	46	24	32	38	35	24	39	37	36	49	38	16	37	27
	Beryllium	6010 / 6020	NSA	mg/kg dry	0.24	0.26	0.29	0.16 J	0.26	0.24	0.24 J	0.17 J	0.28	0.26	0.27	0.26 J	0.28	0.13 J	0.31	0.21 J
	Calcium	6010 / 6020	NSA	mg/kg dry	830	1300	8500	2700	1400	1500	1100	850	1300	970	1000	890	1200	590	1100	1200
	Cadmium	6010 / 6020	0.58	mg/kg dry	0.28 U	0.23 U	0.26 U	0.24 U	0.26 U	0.22 U	< 0.24	0.23 U	0.28 U	0.24 U	0.25 U	0.28 U	0.27 U	< 0.23	0.29 U	0.24 U
	Chromium	6010 / 6020	26	mg/kg dry	6.7	7.1	8.2	5.3	6.2	6.2	6.1	5	7.8	7.8	7.8	7.1	7.7	5.9	7.8	6.3
	Cobalt	6010 / 6020	50	mg/kg dry	5.2	6.4	7.1	5	6.8	8.4	6.3	4.1	6.8	5	6.7	7.2	7.4	4.8	7.6	7.7
	Copper	6010 / 6020	16	mg/kg dry	**23**	**50**	**58**	**18**	**17**	**23**	**23**	**17**	**22**	**28**	**24**	**22**	**20**	**36**	**21**	**18**
	Iron	6010 / 6020	20000	mg/kg dry	13000	13000	14000	12000	14000	16000	13000	12000	16000	12000	16000 J	15000	14000	11000	15000	13000
	Lead	6010 / 6020	31	mg/kg dry	18	**45**	17	24	11	20	**48**	12	13	23	14	11	8.2	**600**	7.7	8.2
	Magnesium	6010 / 6020	NSA	mg/kg dry	3300	3000	5300	3600	3300	3000	2800	2300	4100	2800	4300	4000	4400	2200	4400	3400
	Manganese	6010 / 6020	460	mg/kg dry	140	170	260	150	170	420	91	180	210	91	160	160	87	110	200	190
	Mercury	7470A / 7471B	0.17	mg/kg dry	< 0.028	0.061	0.021 J	< 0.024	0.0085 J	0.0099 J	< 0.022	0.02 J	< 0.025	0.013 J	0.020 J	< 0.025	< 0.026	< 0.024	0.026 J	< 0.022
	Nickel	6010 / 6020	16	mg/kg dry	9	9.9	12	8.6	13	10	9.2	8.9	12	8.8	12	13	10	7.6	11	9.4
	Potassium	6010 / 6020	NSA	mg/kg dry	900	760	1200	690	1000	880	750	590	1200	980	1100	1100	1400	560	1300	910
	Selenium	6010 / 6020	2	mg/kg dry	0.70 U	0.57 U	0.66 U	0.61 U	0.64 U	0.56 U	0.59 U	0.57 U	0.70 U	0.59 U	0.63 U	0.71 U	0.68 U	0.57 U	0.73 U	0.59 U
	Silver	6010 / 6020	0.5	mg/kg dry	< 1.4	< 1.1	< 1.3	< 1.2	< 1.3	< 1.1	< 1.2	< 1.1	< 1.4	< 1.2	< 1.3	< 1.4	< 1.4	0.053 J	< 1.5	< 1.2
	Sodium	6010 / 6020	NSA	mg/kg dry	<140	< 110	< 130	< 120	< 130	< 110	< 120	< 110	< 140	< 120	< 130	< 140	< 140	< 110	< 150	< 120
	Thallium	6010 / 6020	NSA	mg/kg dry	0.56 U	0.46 U	0.52 U	0.49 U	0.52 U	0.45 U	0.48 U	0.46 U	0.56 U	0.48 U	0.51 U	0.57 U	0.54 U	0.46 U	0.59 U	0.47 U
	Vanadium	6010 / 6020	NSA	mg/kg dry	10	14	16	14	15	17	18	12	16	15	17	15	17	9.6	18	17
	Zinc	6010 / 6020	98	mg/kg dry	26	34	28	22	32	31	22	21	30	70	31	30	31	24	28	24

Notes:

Screening level for PCBs is for total PCB concentration.
Bold - Detection is above media Screening Levels
NSA - No screening level available.
" < " - The analyte is not detected above the reporting quantitation limit.
U - Analyte not detected above the reported amount as a result of validation rules.
J - The analyte is positively idenitifed. However, the result is an estimated value.
UJ - The analyte was not detected above the reporting quantitation limit. However the reporting limit is approximate.
R - The data is rejected due to a deficiency in quality control criteria.

TABLE 3-9
Near Shore Sediment Results

Type	Analytes	Method	Screening Level mg/Kg	Sample ID	Collection Date	Units	G-RS1SED-0-090709	G-RS1SED-4-090709	G-RS2SED-0-090709	G-RS2SED-3-090709	G-RS3SED-0-090709	G-RS3SED-4-090709	G-RS4SED-0-090709	G-RS4SED-4-090709	G-RS-5SED-0-090809	G-RS5SED-4-090709	G-RS6SED-0-090709	G-RS6SED-3-090709	G-RS7SED-0-090709	G-RS7SED-4-090709	G-RS8SED-0-090709	G-RS8SED-3-090709
					9/7/2009		9/7/2009	9/7/2009	9/7/2009	9/7/2009	9/7/2009	9/7/2009	9/7/2009	9/7/2009	9/8/2009	9/7/2009	9/7/2009	9/7/2009	9/7/2009	9/7/2009	9/7/2009	9/7/2009
Semivolatiles	1-Methylnaphthalene	8270C	NSA	mg/kg dry		< 0.043	0.0086 J	0.0098	0.0056	0.05	0.11	5	0.0033 J	0.0063	0.087	0.0015 J	0.00097 J	< 0.0043	< 0.0036	< 0.0044	0.00027 J
	2,6-Dinitrotoluene	8270C	NSA	mg/kg dry		< 0.029	< 0.024	< 0.014	< 0.013	< 0.14	< 0.12	< 0.12	< 0.11	< 0.014	< 0.012	< 0.013	0.0031 J	< 0.014	< 0.012	< 0.015	< 0.012
	2-Chloronaphthalene	8270C	NSA	mg/kg dry		< 0.14	< 0.12	0.0013 J	0.0037	< 0.027	< 0.023	< 0.024	< 0.023	< 0.0028	< 0.0024	< 0.0026	< 0.0029	< 0.0029	< 0.0024	< 0.0029	< 0.0023
	2-Methylnaphthalene	8270C	0.020	mg/kg dry		0.0069 J	**0.021 J**	0.019	0.011	0.0055 J	0.016 J	**0.47**	0.0048 J	0.013	< 0.0024	0.0028	0.002 J	0.00044 J	0.00035 J	< 0.0029	0.00071 J
	3 & 4 Methylphenol	8270C	NSA	mg/kg dry		< 0.29	< 0.24	0.0023 J	< 0.025	< 0.27	< 0.23	< 0.24	< 0.23	0.0022	< 0.024	< 0.026	0.002 J	0.0071 J	< 0.024	< 0.029	< 0.023
	Acenaphthene	8270C	0.0067	mg/kg dry		< 0.029	< 0.024	0.0016 J	< 0.0025	**0.032**	**0.18**	**1.9**	< 0.023	0.0031	**0.041**	< 0.0026	< 0.0029	< 0.0029	< 0.0024	< 0.0029	< 0.0023
	Acenaphthylene	8270C	0.0059	mg/kg dry		< 0.029	< 0.024	0.0025 J	0.0046	< 0.027	< 0.023	< 0.024	< 0.023	0.0025	< 0.0024	0.00098 J	< 0.0029	< 0.0029	< 0.0024	< 0.0029	< 0.0023
	Anthracene	8270C	0.057	mg/kg dry		0.0078 J	0.014 J	0.0034	0.0057	0.017 J	**0.1**	**0.23**	< 0.023	0.0036	0.01	0.002 J	0.00081 J	0.0012 J	0.00036 J	< 0.0029	< 0.0023
	Benzo(a)anthracene	8270C	0.016	mg/kg dry		**0.04**	0.012 J	0.0034 J	0.0029 J	< 0.034	**0.1**	**0.48**	< 0.028	0.0089	0.0059	0.0058	0.00042 J	0.0022 J	0.00066 J	0.00087 J	< 0.0029
	Benzo(a)pyrene	8270C	0.032	mg/kg dry		0.0066 J	< 0.036	0.0052	0.0064	< 0.041	**0.097**	< 0.035	< 0.034	0.0074	0.0069	0.0062	0.00098 J	< 0.0043	< 0.0036	< 0.0044	< 0.0035
	Benzo(b)fluoranthene	8270C	0.027	mg/kg dry		< 0.029	< 0.024	0.0069	0.013	< 0.027	**0.078**	< 0.024	< 0.023	0.018	0.0052	0.01	0.0015 J	0.0024 J	< 0.0024	< 0.0029	< 0.0023
	Benzo(g,h,i)perylene	8270C	0.17	mg/kg dry		< 0.036	0.022 J	0.0074	0.015	0.028 J	0.038	0.12	< 0.028	0.009	0.005	0.0049	0.0023 J	< 0.0036	< 0.0030	< 0.0037	< 0.0029
	Benzo(k)fluoranthene	8270C	0.027	mg/kg dry		< 0.036	< 0.030	0.0016 J	0.0015 J	< 0.034	**0.027 J**	< 0.030	< 0.028	0.0037	< 0.0030	0.0022 J	0.00061 J	< 0.0036	< 0.0030	< 0.0037	< 0.0029
	Benzoic acid	8270C	0.65	mg/kg dry		< 3.6	< 3.0	0.099 J	0.12 J	< 3.4	< 2.9	< 3.0	< 2.8	0.11	< 0.30	< 0.33	< 0.37	< 0.36	< 0.30	< 0.37	< 0.29
	Benzyl alcohol	8270C	NSA	mg/kg dry		< 0.14	< 0.12	< 0.014	< 0.013	< 0.14	< 0.12	< 0.12	< 0.11	< 0.014	< 0.012	< 0.013	< 0.015	< 0.014	< 0.012	0.0017 J	< 0.012
	Bis(2-ethylhexyl)phthalate	8270C	0.18	mg/kg dry		< 2.1	< 1.8	< 0.21	0.0078 J	< 2.1	< 1.8	< 1.8	< 1.7	0.0076	< 0.18	0.01 J	0.0068 J	< 0.22	< 0.18	< 0.22	< 0.17
	Carbazole	8270C	NSA	mg/kg dry		< 0.21	< 0.18	0.0013 J	0.0023 J	< 0.21	< 0.18	< 0.18	< 0.17	0.0024	< 0.018	0.0011 J	< 0.022	< 0.022	< 0.018	< 0.022	0.00075 J
	Chrysene	8270C	0.027	mg/kg dry		0.0098 J	**0.029 J**	0.0083	0.016	< 0.034	**0.29**	**1**	0.0035 J	0.021	0.013	0.0085	0.0033 J	0.0054	< 0.0030	< 0.0037	< 0.0029
	Dibenzo(a,h)anthracene	8270C	0.0062	mg/kg dry		< 0.057	< 0.047	0.0017 J	< 0.0051	< 0.055	< 0.047	< 0.047	< 0.046	0.0026	< 0.0048	0.0017 J	< 0.0059	< 0.0058	< 0.0048	< 0.0059	< 0.0047
	Dibenzofuran	8270C	0.42	mg/kg dry		< 0.14	0.015 J	0.0032 J	0.003 J	< 0.14	< 0.12	< 0.12	< 0.11	0.0064	< 0.012	0.00093 J	< 0.015	< 0.014	< 0.012	< 0.015	< 0.012
	Diethylphthalate	8270C	0.60	mg/kg dry		< 0.14	< 0.12	< 0.014	0.013 U	< 0.14	< 0.12	< 0.12	< 0.11	0.014 U	< 0.012	0.013 U	< 0.015	0.014 U	0.012 U	0.015 U	0.012 U
	Di-n-butyl phthalate	8270C	0.11	mg/kg dry		< 0.29	< 0.24	0.028 U	0.025 U	< 0.27	< 0.23	< 0.24	< 0.23	0.028 U	< 0.024	0.026 U	0.029 U	0.029 U	0.024 U	0.029 U	0.023 U
	Di-n-octyl phthalate	8270C	NSA	mg/kg dry		< 0.29	< 0.24	0.0018 J	< 0.025	< 0.27	< 0.23	< 0.24	< 0.23	0.0039	< 0.024	< 0.026	< 0.029	< 0.029	< 0.024	< 0.029	< 0.023
	Fluoranthene	8270C	0.03	mg/kg dry		0.016 J	**0.04**	0.0065	0.0045	< 0.027	**0.15**	**0.68**	0.0065 J	0.013	0.0078	0.014	0.0016 J	0.014	0.00036 J	0.0011 J	0.00066 J
	Fluorene	8270C	0.010	mg/kg dry		< 0.029	< 0.024	< 0.0028	< 0.0025	**0.059**	**0.17**	**3.1**	< 0.023	0.0047	**0.08**	< 0.0026	< 0.0029	< 0.0029	< 0.0024	< 0.0029	< 0.0023
	Indeno(1,2,3-cd)pyrene	8270C	0.017	mg/kg dry		**0.024 J**	**0.035 J**	0.0043 J	0.0064	< 0.055	**0.025 J**	< 0.047	< 0.046	0.0053	0.0023 J	0.004 J	0.0016 J	< 0.0058	< 0.0048	< 0.0059	< 0.0047
	Isophorone	8270C	NSA	mg/kg dry		< 0.14	< 0.12	< 0.014	< 0.013	< 0.14	0.022 J	< 0.12	< 0.11	< 0.014	< 0.012	< 0.013	< 0.015	< 0.014	< 0.012	< 0.015	< 0.012
	Naphthalene	8270C	0.015	mg/kg dry		< 0.029	**0.019 J**	0.0068	0.005	< 0.027	< 0.023	< 0.024	< 0.023	0.0081	0.013	0.0016 J	< 0.0029	< 0.0029	< 0.0024	< 0.0029	0.00048 J
	Phenanthrene	8270C	0.019	mg/kg dry		0.017 J	**0.04**	0.01	0.01	**0.078**	**0.48**	**5**	< 0.023	0.015	**0.08**	0.0043	0.0014 J	0.0081	0.00053 J	< 0.0029	< 0.0023
	Phenol	8270C	0.048	mg/kg dry		< 0.14	< 0.12	0.0055 J	0.0021 J	< 0.14	< 0.12	< 0.12	< 0.11	0.0023	< 0.012	0.0012 J	< 0.015	< 0.014	< 0.012	< 0.015	< 0.012
	Pyrene	8270C	0.044	mg/kg dry		0.013 J	**0.047**	0.01	0.013	**0.092**	**0.54**	**2.3**	0.023	0.017	0.027	0.013	< 0.0029	0.012	0.00072 J	0.001 J	0.00078 J
Volatile Organics	1,1,2,2,-Tetrachloroethane	8260B	1.36	mg/kg dry		< 0.0013	0.00018 J	< 0.0023	< 0.0044	< 0.0033	< 0.0016	< 0.0022	< 0.0016	< 0.0025	< 0.0019	< 0.0030	0.00027 J	< 0.0028	< 0.0021	< 0.0024	< 0.0031
	1,2,3-Trichlorobenzene	8260B	0.86	mg/kg dry		0.0025 U	0.0021 U	< 0.0023	< 0.0044	< 0.0033	0.0016 U	< 0.0022	< 0.0016	< 0.0025	< 0.0019	< 0.0030	0.0028 U	< 0.0028	< 0.0021	< 0.0024	0.0031 U
	1,2,4-Trichlorobenzene	8260B	2.1	mg/kg dry		0.0013 U	0.0021 U	< 0.0023	< 0.0044	< 0.0033	< 0.0016	< 0.0022	< 0.0016	< 0.0025	< 0.0019	< 0.0030	0.00088 J	< 0.0028	< 0.0021	< 0.0024	< 0.0031
	1,2,4-Trimethylbenzene	8260B	NSA	mg/kg dry		< 0.0013	0.00077 J	< 0.0012	< 0.0022	< 0.0016	< 0.00080	< 0.0011	< 0.00078	< 0.0012	< 0.00093	< 0.0015	0.00072 J	< 0.0014	< 0.0011	< 0.0012	< 0.0015
	1,2-Dibromo-3-Chloroprop	8260B	NSA	mg/kg dry		< 0.0025	0.00045 J	< 0.0023	< 0.0044	< 0.0033	< 0.0016	< 0.0022	< 0.0016	< 0.0025	< 0.0019	< 0.0030	0.00054 J	< 0.0028	< 0.0021	< 0.0024	< 0.0031
	1,2-Dichlororbenzene	8260B	0.017	mg/kg dry		< 0.0013	0.00059 J	< 0.0012	< 0.0022	0.0023	< 0.00080	0.0019 J	< 0.00078	< 0.0012	0.00039 J	< 0.0015	0.00057 J	< 0.0014	< 0.0011	< 0.0012	< 0.0015
	1,3,5-Trimethylbenzene	8260B	NSA	mg/kg dry		< 0.0025	0.0006 J	< 0.0023	< 0.0044	< 0.0033	< 0.0016	< 0.0022	< 0.0016	< 0.0025	< 0.0019	< 0.0030	0.00054 J	< 0.0028	< 0.0021	< 0.0024	< 0.0031
	1,3-Dichlorobenzene	8260B	4.43	mg/kg dry		< 0.0013	0.00049	< 0.0012	< 0.0022	< 0.0016	< 0.00080	< 0.0011	< 0.00078	< 0.0012	< 0.00093	< 0.0015	0.00054 J	< 0.0014	< 0.0011	< 0.0012	< 0.0015
	1,4-Dichlorobenzene	8260B	0.60	mg/kg dry		< 0.0013	0.0010 U	< 0.0012	< 0.0022	0.00094 J	< 0.00080	< 0.0011	< 0.00078	< 0.0012	< 0.00093	< 0.0015	0.0007 J	< 0.0014	< 0.0011	< 0.0012	< 0.0015
	2-Chlorotoluene	8260B	NSA	mg/kg dry		< 0.0013	0.00035 J	< 0.0012	< 0.0022	< 0.0016	< 0.00080	< 0.0011	< 0.00078	< 0.0012	< 0.00093	< 0.0015	0.00029 J	< 0.0014	< 0.0011	< 0.0012	< 0.0015
	4-Chlorotoluene	8260B	NSA	mg/kg dry		< 0.0013	0.00046 J	< 0.0012	< 0.0022	< 0.0016	< 0.00080	< 0.0011	< 0.00078	< 0.0012	< 0.00093	< 0.0015	< 0.0014	< 0.0014	< 0.0011	< 0.0012	< 0.0015
	4-Isopropyltoluene	8260B	NSA	mg/kg dry		0.00081 J	0.0011	0.0072 J	0.0015 J	0.002	< 0.00080	0.0041 J	< 0.00078	< 0.0012	0.00045 J	< 0.0015	0.0022	0.00097	< 0.0011	0.00078 J	< 0.0015
	Benzene	8260B	NSA	mg/kg dry		0.0013 U	0.0013	0.0012 U	0.0022 U	0.0016 U	0.00080 U	0.0011 U	0.00078 U	0.0012 U	0.00093 U	0.0015 U	0.0014 U	0.0014 U	0.0011 U	0.0012 U	0.0015 U
	Bromobenzene	8260B	NSA	mg/kg dry		< 0.0013	0.00033 J	< 0.0012	< 0.0022	< 0.0016	< 0.00080	< 0.0011	< 0.00078	< 0.0012	< 0.00093	< 0.0015	0.00035 J	< 0.0014	< 0.0011	< 0.0012	< 0.0015
	Chlorobenzene	8260B	0.0084	mg/kg dry		0.0013 U	0.0011	0.003 J	0.0022 U	0.0016 U	0.00080 U	0.0011 U	0.00078 U	0.0012 U	0.0010 U	0.0015 U	0.0014 U	0.0014 U	0.0011 U	0.0012 U	0.0015 U
	Chloromethane	8260B	NSA	mg/kg dry		< 0.0013	0.0032	0.0008 J	< 0.0022	< 0.0016	< 0.00080	< 0.0011	< 0.00078	< 0.0012	< 0.00093	< 0.0015	< 0.0014	< 0.0014	< 0.0011	< 0.0012	< 0.0015
	Ethylbenzene	8260B	1.1	mg/kg dry		< 0.0013	0.00035 J	< 0.0012	< 0.0022	< 0.0016	< 0.00080	< 0.0011	< 0.00078	< 0.0012	< 0.00093	< 0.0015	0.00028 J	< 0.0014	< 0.0011	< 0.0012	< 0.0015
	Hexachlorobutadiene	8260B	NSA	mg/kg dry		0.00047 J	0.0011	< 0.0012	< 0.0022	< 0.0016	< 0.00080	< 0.0011	< 0.00078	< 0.0012	< 0.00093	< 0.0015	0.00093 J	< 0.0014	< 0.0011	< 0.0012	< 0.0015
	Isopropylbenzene	8260B	0.086	mg/kg dry		< 0.0013	0.0003 J	< 0.0012	< 0.0022	0.0028	< 0.00080	0.0025 J	< 0.00078	< 0.0012	0.0005 J	< 0.0015	0.00029 J	< 0.0014	< 0.0011	< 0.0012	< 0.0015
	Methylene Chloride	8260B	NSA	mg/kg dry		< 0.0013	< 0.0010	< 0.0012	< 0.0022	< 0.0016	< 0.00080	< 0.0011	< 0.00078	< 0.0012	< 0.00093	< 0.0015	< 0.0014	< 0.0014	< 0.0011	< 0.0012	< 0.0015
	m-Xylene & p-Xylene	8260B	0.025	mg/kg dry		0.0025 U	0.0021 U	0.0023 U	< 0.0044	0.00048 J	0.00014 J	< 0.0022	< 0.0016	< 0.0025	0.00022 J	0.00029 J	0.00065 J	0.00024 U	0.0021 U	0.0024 U	< 0.0031
	Naphthalene	8260B	0.015	mg/kg dry		0.0063 U	0.0052 U	0.0058 U	< 0.011	0.0035 J	< 0.0040	0.0062 J	< 0.0039	< 0.0062	0.0034 J	< 0.0074	0.0018 J	< 0.0071	< 0.0053	< 0.0060	< 0.0077
	n-Butylbenzene	8260B	NSA	mg/kg dry		0.00052 J	0.0012	< 0.0012	< 0.0022	0.0092	< 0.00080	0.018 J	< 0.00078	< 0.0012	< 0.00093	< 0.0015	0.0011 J	< 0.0014	< 0.0011	< 0.0012	< 0.0015
	N-Propylbenzene	8260B	NSA	mg/kg dry		0.0002 J	0.00054 J	< 0.0012	< 0.0022	0.00072 J	< 0.00080	< 0.0011	< 0.00078	< 0.0012	0.00045 J	< 0.0015	0.00088 J	< 0.0014	< 0.0011	< 0.0012	< 0.0015
	o-Xylene	8260B	NSA	mg/kg dry		0.0013 U	0.0010 U	0.0012 U	0.0022 U	0.00097 J	0.000077 J	< 0.0011	0.000049 J	< 0.0012	0.00014 J	0.00012 J	0.00036 J	0.0014 U	0.0011 U	< 0.0012	0.0015 U
	sec-Butylbenzene	8260B	NSA	mg/kg dry		< 0.0013	0.00081 J	< 0.0012	< 0.0022	0.0065	< 0.00080	0.01 J	< 0.00078	< 0.0012	0.0014	< 0.0015	0.00072 J	< 0.0014	< 0.0011	< 0.0012	< 0.0015
	Styrene	8260B	0.56	mg/kg dry		< 0.0013	0.00051 J	< 0.0012	< 0.0022	< 0.0016	< 0.00080	< 0.0011	< 0.00078	< 0.0012	< 0.00093	< 0.0015	0.00049 J	< 0.0014	< 0.0011	< 0.0012	< 0.0015
	tert-Butylbenzene	8260B	NSA	mg/kg dry		< 0.0013	0.00082 J	< 0.0012	< 0.0022	0.00089 J	< 0.00080	< 0.0011	< 0.00078	< 0.0012	< 0.00093	< 0.0015	0.00062 J	< 0.0014	< 0.0011	< 0.0012	< 0.0015
	Toluene	8260B	NSA	mg/kg dry		0.0013 U	0.0010 U	0.0012 U	0.0022 U	0.0016 U	0.00080 U	0.0014 J	0.00078 U	0.0012 U	0.00093 U	0.0015 U	0.0022	0.0018	0.0011 U	0.0012 U	0.0015 U

Notes:

Bold - Detection is above media Screening Levels
NSA - No screening level available.
" < " - The analyte is not detected above the reporting quantitation limit.
U - Analyte not detected above the reported amount as a result of validation rules.
J - The analyte is positively idenitifed. However, the result is an estimated value.
UJ - The analyte was not detected above the reporting quantitation limit. However the reporting limit is approximate.
R - The data is rejected due to a deficiency in quality control criteria.

TABLE 3-10
Near Shore Surface Water Results

Type	Analytes	Method	Screening Level ug/L	Sample ID	G-RS1SW-090609	G-RS2SW-090609	G-RS3SW-090609	G-RS4SW-090609	G-RS5SW-090609	G-RS5SW-090609	G-RS6SW-090609	G-RS7SW-090609	G-RS8SW-090609
				Collection Date	9/6/2009	9/6/2009	9/6/2009	9/6/2009	9/6/2009	9/6/2009	9/6/2009	9/6/2009	9/6/2009
				Units									
TPH	Diesel Range Organics	NWTPH-Dx	NSA	ug/L	< 250	< 260	< 266	< 248	< 240	---	< 278	< 245	< 240
	Heavy Oils	NWTPH-Dx	NSA	ug/L	< 500	< 521	< 532	< 495	< 481	---	< 556	< 490	< 481
PCBs	Aroclor 1016	8082	0.000064	ug/L	< 0.050	< 0.048	< 0.049	< 0.050	<0.047	---	< 0.050	< 0.049	< 0.048
	Aroclor 1221	8082	0.000064	ug/L	< 0.050	< 0.048	< 0.049	< 0.050	<0.047	---	< 0.050	< 0.049	< 0.048
	Aroclor 1232	8082	0.000064	ug/L	< 0.050	< 0.048	< 0.049	< 0.050	<0.047	---	< 0.050	< 0.049	< 0.048
	Aroclor 1242	8082	0.000064	ug/L	< 0.050	< 0.048	< 0.049	< 0.050	<0.047	---	< 0.050	< 0.049	< 0.048
	Aroclor 1248	8082	0.000064	ug/L	< 0.050	< 0.048	< 0.049	< 0.050	<0.047	---	< 0.050	< 0.049	< 0.048
	Aroclor 1254	8082	0.000064	ug/L	< 0.050	< 0.048	< 0.049	< 0.050	<0.047	---	< 0.050	< 0.049	< 0.048
	Aroclor 1260	8082	0.000064	ug/L	< 0.050	< 0.048	< 0.049	< 0.050	<0.047	---	< 0.050	< 0.049	< 0.048
Carcinogenic PAH	Benzo(a)anthracene	8270 SIM	0.0038	ug/L	< 0.0096	< 0.0099	< 0.0094	**0.0077 J**	< 0.011	---	< 0.01	< 0.0095	< 0.0095
	Benzo(a)pyrene	8270 SIM	0.0038	ug/L	< 0.019	< 0.02	< 0.019	< 0.02	< 0.022	---	< 0.02	< 0.019	< 0.019
	Benzo(b)fluoranthene	8270 SIM	0.0038	ug/L	< 0.0096	< 0.0099	< 0.0094	< 0.0099	< 0.011	---	< 0.01	< 0.0095	< 0.0095
	Benzo(k)fluoranthene	8270 SIM	0.0038	ug/L	< 0.0096	< 0.0099	< 0.0094	< 0.0099	< 0.011	---	< 0.01	< 0.0095	< 0.0095
	Chrysene	8270 SIM	0.0038	ug/L	< 0.0096	< 0.0099	< 0.0094	**0.015**	< 0.011	---	< 0.01	< 0.0095	< 0.0095
	Dibenzo(a,h)anthracene	8270 SIM	0.0038	ug/L	< 0.0096	< 0.0099	< 0.0094	< 0.0099	< 0.011	---	< 0.01	< 0.0095	< 0.0095
	Indeno(1,2,3-cd)pyrene	8270 SIM	0.0038	ug/L	< 0.0096	< 0.0099	< 0.0094	< 0.0099	< 0.011	---	< 0.01	< 0.0095	< 0.0095
Non- Carcinogenic PAH	Acenaphthene	8270 SIM	670	ug/L	0.0012 J	0.0099 U	0.0094 U	0.044	0.059	---	0.0025 J	0.0095 U	0.0017 J
	Acenaphthylene	8270 SIM	NSA	ug/L	< 0.0096	< 0.0099	< 0.0094	0.0094 J	0.0071 J	---	< 0.01	0.0015 J	< 0.0095
	Anthracene	8270 SIM	8300	ug/L	0.0011 J	0.0099 U	0.0094 U	0.021	0.0049 J	---	0.0015 J	0.0095 U	0.0011 J
	Benzo(g,h,i)perylene	8270 SIM	NSA	ug/L	< 0.0096	< 0.0099	< 0.0094	< 0.0099	< 0.011	---	< 0.01	< 0.0095	< 0.0095
	Fluoranthene	8270 SIM	130	ug/L	0.0020 J	0.0099 U	0.0094 U	0.017	0.0038 J	---	0.0025 J	0.0095 U	0.0022 J
	Fluorene	8270 SIM	1100	ug/L	0.0026 J	0.0099 U	0.0094 U	0.13	0.097	---	0.0045 J	0.0095 U	0.0026 J
	Naphthalene	8270 SIM	NSA	ug/L	< 0.0096	< 0.0099	< 0.0094	0.0099 U	0.054	---	< 0.01	< 0.0095	< 0.0095
	Phenanthrene	8270 SIM	NSA	ug/L	0.0040 J	0.0099 U	0.0094 U	0.21	0.035	---	0.0085 J	0.0095 U	0.0033 J
	Pyrene	8270 SIM	830	ug/L	< 0.0096	0.0099 U	0.0094 U	0.039	0.0049 J	---	0.0022 J	0.0095 U	0.0023 J
	1-Methylnaphthalene	8270 SIM	NSA	ug/L	0.0024 J	0.0099 U	0.0094 U	0.11	0.21	---	0.0056 J	0.0095 U	0.0041 J
	2-Methylnaphthalene	8270 SIM	NSA	ug/L	< 0.012	< 0.013	< 0.012	0.013 U	0.013 J	---	< 0.013	< 0.012	< 0.012
Total Metals	Aluminum	6010 / 6020	NSA	ug/L	< 500	< 500	< 500	< 500	< 500	---	< 500	< 500	< 500
	Arsenic	6010 / 6020	50	ug/L	< 2	< 2	< 2	< 2	0.52 J	---	1.1 J	< 2	< 2
	Antimony	6010 / 6020	5.6	ug/L	< 2	< 2	< 2	< 2	< 2	---	< 2	< 2	< 2
	Barium	6010 / 6020	NSA	ug/L	7.9	8.1	7.2	7.9	13	---	8	7.6	7.2
	Beryllium	6010 / 6020	NSA	ug/L	< 2	< 2	< 2	< 2	< 2	---	< 2	< 2	< 2
	Calcium	6010 / 6020	NSA	ug/L	12000	12000	11000	11000	15000	---	11000	11000	11000
	Cadmium	6010 / 6020	0.6	ug/L	<0.14*	<0.14*	<0.14*	<0.14*	<0.14*	---	<0.14*	<0.14*	<0.14*
	Chromium	6010 / 6020	74	ug/L	0.46 J	< 2	< 2	0.44 J	< 2	---	0.38 J	0.42 J	0.51 J
	Cobalt	6010 / 6020	NSA	ug/L	< 2	< 2	< 2	< 2	< 2	---	< 2	< 2	< 2
	Copper	6010 / 6020	11	ug/L	0.75 J	0.9 J	0.74 J	0.78 J	0.8 J	---	0.84 J	0.76 J	0.77 J
	Iron	6010 / 6020	NSA	ug/L	< 200	51 J	< 200	41 J	1700	590	68 J	< 200	< 200
	Lead	6010 / 6020	2.5	ug/L	< 2	< 2	< 2	< 2	< 2	---	< 2	< 2	< 2
	Magnesium	6010 / 6020	NSA	ug/L	2500	2400	2400	2300	3000	---	2300	2300	2300
	Manganese	6010 / 6020	NSA	ug/L	< 20	< 20	< 20	11 J	160	130	11 J	7.6 J	1.9 J
	Mercury	7470A / 7471B	NSA	ug/L	< 0.2	0.12 J	< 0.2	< 0.2	< 0.2	---	0.12 J	< 0.2	< 0.2
	Nickel	6010 / 6020	52	ug/L	0.53 J	0.52 J	0.46 J	0.38 J	0.58 J	---	0.46 J	0.47 J	0.39 J
	Potassium	6010 / 6020	NSA	ug/L	660 J	670 J	680 J	660 J	760 J	---	680 J	690 J	680 J
	Selenium	6010 / 6020	5	ug/L	< 2	< 2	< 2	< 2	< 2	---	< 2	< 2	< 2
	Silver	6010 / 6020	3.4	ug/L	< 2	< 2	< 2	< 2	< 2	---	< 2	< 2	< 2
	Sodium	6010 / 6020	NSA	ug/L	1100 J	1100 J	1000 J	1000 J	1200 J	---	1000 J	1000 J	1000 J
	Thallium	6010 / 6020	0.24	ug/L	< 4	< 4	< 4	0.14 J	< 4	---	< 4	< 4	< 4
	Vanadium	6010 / 6020	NSA	ug/L	0.28 J	< 2	< 2	< 2	< 2	---	< 2	< 2	< 2
	Zinc	6010 / 6020	120	ug/L	< 7	< 7	< 7	< 7	< 7	---	< 7	< 7	< 7

Notes: * Indicates a minimum detection limit.
Shading indicates dissolved metals analysis.
Bold - Detection is above media Screening Levels
NSA - No screening level available.
" < " - The analyte is not detected above the reporting quantitation limit.
U - Analyte not detected above the reported amount as a result of validation rules.
J - The analyte is positively idenitifed. However, the result is an estimated value.
UJ - The analyte was not detected above the reporting quantitation limit. However the reporting limit is approximate.
R - The data is rejected due to a deficiency in quality control criteria.

TABLE 3-11
Stream Gauge Measurements

Date	Time	Gauge Reading (ft.)	Water Elevation (ft amsl)
9/9/2009	15:09	0.8	2466.26
10/2/2009	13:40	0.68	2466.14
10/11/2009	11:05	0.64	2466.1
10/17/2009	11:25	0.70	2466.16
10/24/2009	8:45	1.00	2466.46
11/2/2009	8:13	0.82	2466.28
11/7/2009	9:00	0.92	2466.38
11/19/2009	15:50	0.68	2466.14

Note: Surveyed measuring point is the 8 foot mark on the stream gauge (2473.46 ft. amsl)

TABLE 3-12
Field QA/QC Sample Results

Sample ID	G-EB-090509	G-EB-090709	G-GA3-090309	G-GA3D-090309	G-GA3S-090309	G-RS-5SED-0-090809	G-RS5DSED-0-090709	G-RS-5SSED-0-090809	G-RS3SW-090609	G-RS3SSW-090609	G-RS3DSW-090609	G-GA3-20-082609	GA-D2-082609	GA-D-082609
QA/QC Sample Type	GW Equipment	Sediment Equipment	Parent Sample	Duplicate Sample	Split Sample	Parent	Duplicate Sample	Split Sample	Parent Sample	Duplicate Sample	Split Sample	Parent Sample	Duplicate Sample	Split Sample
			Groundwater	Groundwater	Groundwater	Sediment	Sediment	Sediment	Surface Water	Surface Water	Surface Water	Soil	Soil	Soil
Analytes	ug/L	ug/L	ug/L	ug/L	ug/L	mg/kg	mg/kg	mg/kg	ug/L	ug/L	ug/L	mg/kg	mg/kg	mg/kg
Diesel Range Organics	<0.000240	<0.000245	< 243	< 250	< 250	24.3	36.9	63	< 266	< 250	< 236	22.9 J	39.4 J	50.1 J
Heavy Oils	<0.000481	<0.00049	< 485	< 500	< 500	112	182	79	< 532	<500	< 472	70.7 J	119 J	88.1 J
Aroclor 1016	<0.047	<0.047	< 0.047	< 0.047	< 0.010	<0.010	<0.010	< 0.031	< 0.049	< 0.010	< 0.048	< 9.59	< 9.93	< 9.89
Aroclor 1221	<0.0058*	<0.0058*	0.047 UJ	0.047 UJ	< 0.010	<0.010	<0.010	< 0.031	< 0.049	< 0.010	< 0.048	< 9.59	< 9.93	< 9.89
Aroclor 1232	<0.0039*	<0.0039*	0.047 UJ	0.047 UJ	< 0.010	<0.010	<0.010	< 0.031	< 0.049	< 0.010	< 0.048	< 9.59	< 9.93	< 9.89
Aroclor 1242	<0.0039*	<0.0039*	0.047 UJ	0.047 UJ	< 0.010	<0.010	<0.010	< 0.031	< 0.049	< 0.010	< 0.048	< 9.59	< 9.93	< 9.89
Aroclor 1248	<0.0037*	<0.0067*	0.047 UJ	0.047 UJ	< 0.010	<0.010	<0.010	< 0.031	< 0.049	< 0.010	< 0.048	< 9.59	< 9.93	< 9.89
Aroclor 1254	<0.0042*	<0.0042*	0.047 UJ	0.047 UJ	< 0.010	<0.010	<0.010	< 0.031	< 0.049	< 0.010	< 0.048	< 9.59	< 9.93	< 9.89
Aroclor 1260	<0.0037*	<0.0037*	< 0.047	< 0.047	< 0.010	<0.010	<0.010	< 0.031	< 0.049	< 0.010	< 0.048	< 9.59	< 9.93	< 9.89
Benzo(a)anthracene	<0.0094	<0.0094	< 0.0094	< 0.0094	< 0.010	0.00586	< 0.00489	< 0.0046	< 0.0094	< 0.010	< 0.0094	0.00457 UJ	0.00451 UJ	0.00449 UJ
Benzo(a)pyrene	<0.0018*	<0.0018*	< 0.019	< 0.019	< 0.010	0.00521	< 0.00489	0.018	< 0.019	< 0.010	< 0.019	0.00457 UJ	0.00451 UJ	0.00449 UJ
Benzo(b)fluoranthene	<0.0094	<0.0094	< 0.0094	< 0.0094	< 0.010	< 0.00488	0.00587	0.0083	< 0.0094	< 0.010	< 0.0094	0.00457 UJ	0.00451 UJ	0.00449 UJ
Benzo(k)fluoranthene	<0.0094	<0.0094	< 0.0094	< 0.0094	< 0.010	0.01040	< 0.00489	0.0083	< 0.0094	< 0.010	< 0.0094	0.00457 UJ	0.00451 UJ	0.00449 UJ
Chrysene	<0.0094	<0.0094	< 0.0094	< 0.0094	< 0.010	0.00976	< 0.00489	0.028	< 0.0094	< 0.010	< 0.0094	0.00457 UJ	.00652 J	0.00549 J
Dibenzo(a,h)anthracene	<0.0017*	<0.0017*	< 0.0094	< 0.0094	< 0.010	< 0.00488	0.00522	< 0.0046	< 0.0094	< 0.010	< 0.0094	0.00457 UJ	0.00451 UJ	0.00449 UJ
Indeno(1,2,3-cd)pyrene	<0.0094	<0.0094	< 0.0094	< 0.0094	< 0.010	< 0.00488	0.00718	0.0065	< 0.0094	< 0.010	< 0.0094	0.00457 UJ	0.00451 UJ	0.00449 J
Acenaphthene	0.038	0.018	0.025	0.025	0.016	< 0.00488	< 0.00489	< 0.0046	0.0094 U	< 0.010	0.0094 U	0.00457 UJ	0.00451 UJ	0.00449 UJ
Acenaphthylene	<0.0094	0.0013	0.0050 J	0.0048 J	< 0.010	< 0.00488	< 0.00489	< 0.0046	< 0.0094	< 0.010	< 0.0094	0.00457 UJ	0.00451 UJ	0.00449 UJ
Anthracene	0.0012	<0.0012	< 0.0094	< 0.0094	< 0.010	< 0.00488	< 0.00489	< 0.0046	0.0094 U	< 0.010	0.0094 U	0.00457 UJ	0.00451 UJ	0.00749 J
Benzo(g,h,i)perylene	<00094	<0.0094	< 0.0094	< 0.0094	< 0.010	0.00586	0.00848	0.017	< 0.0094	< 0.010	< 0.0094	0.00457 UJ	0.00451 UJ	0.00449 UJ
Fluoranthene	<0.0094	0.0026	0.0087 J	0.0049 J	< 0.010	0.00716	< 0.00489	0.0079	0.0094 U	< 0.010	0.0094 U	0.00457 UJ	0.00451 UJ	0.00449 UJ
Fluorene	0.0034	0.0026	0.019	0.017	< 0.010	< 0.00488	< 0.00489	0.0051	0.0094 U	< 0.010	0.0094 U	0.00457 UJ	0.00451 UJ	0.00599 J
Naphthalene	0.021	0.014	0.040	0.038	0.045 J	< 0.00488	< 0.00489	< 0.0046	< 0.0094	< 0.010	< 0.0094	0.00457 UJ	0.00451 UJ	0.00449 UJ
Phenanthrene	0.0047	<0.0034	0.020	0.019 U	< 0.010	< 0.00488	< 0.00489	0.0083	0.0094 U	< 0.010	0.0094 U	0.00457 UJ	0.00451 UJ	0.00449 UJ
Pyrene	<0.0094	<0.0094	0.0097 U	0.0094 U	< 0.010	0.01430	< 0.00489	0.059	0.0094 U	< 0.010	0.0094 U	0.00457 UJ	0.00752 J	0.00649 J
1-Methylnaphthalene	0.0098	0.0048	0.021	0.020	0.018	< 0.00488	< 0.00489	< 0.0046	0.0094 U	< 0.010	0.0094 U	0.00457 UJ	0.00451 UJ	0.00449 UJ
2-Methylnaphthalene	0.013	0.0079	0.020	0.019	0.015 J	< 0.00488	< 0.00489	0.006	< 0.012	< 0.010	< 0.012	0.00457 UJ	0.00451 UJ	0.00449 UJ
Aluminum	<50	<0.0005	400 U	400 U	< 50	6900	7000	9840	< 500	< 50	< 500	N/A	N/A	N/A
Arsenic	<2	<2	0.91 J	0.72 J	2.6	8.5	9	9.6	< 2	0.4	< 2	N/A	N/A	N/A
Antimony	<2	<2	1.5 J	1.2 J	0.2	1.2	1	< 0.3	< 2	< 0.2	< 2	N/A	N/A	N/A
Barium	<6	<6	38	38	31	39	41	44.7	7.2	6	7.7	N/A	N/A	N/A
Beryllium	<2	<2	< 2.0	< 2.0	< 1	0.28	0.28	0.3	< 2	< 1	< 2	N/A	N/A	N/A
Calcium	<1100	<1100	21000	21000	20400	1300	1400	1690	11000	11100	11000	N/A	N/A	N/A
Cadmium	<2	<2	< 2.0	< 2.0	< 2	0.28 U	0.27 U	< 0.3	< 2	< 2	< 2	N/A	N/A	N/A
Chromium	<2	<2	0.38 J	< 2.0	< 5	7.8	7.9	8.9	< 2	< 5	< 2	N/A	N/A	N/A
Cobalt	<2	<2	0.38 J	0.36 J	< 3	6.8	7	6.7	< 2	< 3	< 2	N/A	N/A	N/A
Copper	<0.66	<0.24	1.6 J	1.7 J	< 2	22	21	20.4	0.74 J	< 2	0.75 J	N/A	N/A	N/A
Iron	<200	<200	53 J	50 J	150	16000	16000	18300	< 200	< 50	< 200	N/A	N/A	N/A
Lead	<2	<2	< 2.0	< 2.0	< 1	13	14	12	< 2	< 1	< 2	N/A	N/A	N/A
Magnesium	<1100	<1100	3300	3300	3280	4100	4100	5480	2400	2350	2300	N/A	N/A	N/A
Manganese	<20	<20	440	450	429	210	190	178	< 20	2	< 20	N/A	N/A	N/A
Mercury	<2	<2	< 0.02	< 0.02	< 0.02	< 0.025	< 0.026	< 0.03	< 0.2	< 0.02	0.09 J	N/A	N/A	N/A
Nickel	0.37	<2	2.4	2.4	< 10	12	11	12 J	0.46 J	< 10	0.43 J	N/A	N/A	N/A
Potassium	<3300	<3300	2400 J	2500 J	2360	1200	1100	1710	680 J	690	640 J	N/A	N/A	N/A
Selenium	<2	<2	< 2.0	< 2.0	< 50	0.70 U	0.68 U	< 0.7	< 2	< 50	< 2	N/A	N/A	N/A
Silver	<2	<2	< 2.0	< 2.0	< 3	< 1.4	< 1.4	< 0.03	< 2	< 3	< 2	N/A	N/A	N/A
Sodium	<2000	<2000	2000 U	1600 U	1620	< 140	< 140	80	1000 J	1320	990 J	N/A	N/A	N/A
Thallium	<2	<2	< 4.0	< 4.0	< 0.2	0.56 U	0.54 U	< 0.3	< 4	< 0.2	< 4	N/A	N/A	N/A
Vanadium	<2	<2	0.75 J	< 2.0	< 3	16	17	18.9	< 2	< 3	< 2	N/A	N/A	N/A
Zinc	<7	9.2	2.5 J	2.3 J	< 10	30	34	37	< 7	< 10	< 7	N/A	N/A	N/A
1-Methylnaphthalene	N/A	N/A	N/A	N/A	N/A	0.0063	0.0038 J	< 0.06	N/A	N/A	N/A	N/A	N/A	N/A
2,6-Dinitrotoluene	N/A	N/A	N/A	N/A	N/A	< 0.014	< 0.014	< 0.3	N/A	N/A	N/A	N/A	N/A	N/A
2-Chloronaphthalene	N/A	N/A	N/A	N/A	N/A	< 0.0028	< 0.0028	< 0.06	N/A	N/A	N/A	N/A	N/A	N/A
2-Methylnaphthalene	N/A	N/A	N/A	N/A	N/A	0.013	0.0052	< 0.06	N/A	N/A	N/A	N/A	N/A	N/A
3 & 4 Methylphenol	N/A	N/A	N/A	N/A	N/A	0.0022	< 0.028	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Acenaphthene	N/A	N/A	N/A	N/A	N/A	0.0031	0.0044	< 0.06	N/A	N/A	N/A	N/A	N/A	N/A
Acenaphthylene	N/A	N/A	N/A	N/A	N/A	0.0025	0.0017 J	< 0.06	N/A	N/A	N/A	N/A	N/A	N/A
Anthracene	N/A	N/A	N/A	N/A	N/A	0.0036	0.0027 J	< 0.06	N/A	N/A	N/A	N/A	N/A	N/A
Benzo(a)anthracene	N/A	N/A	N/A	N/A	N/A	0.0089	0.0042	< 0.06	N/A	N/A	N/A	N/A	N/A	N/A
Benzo(a)pyrene	N/A	N/A	N/A	N/A	N/A	0.0074	0.0056	< 0.06	N/A	N/A	N/A	N/A	N/A	N/A
Benzo(b)fluoranthene	N/A	N/A	N/A	N/A	N/A	0.018	0.0076	< 0.06	N/A	N/A	N/A	N/A	N/A	N/A
Benzo[g.h.j]perylene	N/A	N/A	N/A	N/A	N/A	0.009	0.0083	< 0.06	N/A	N/A	N/A	N/A	N/A	N/A
Benzo[k]fluoranthene	N/A	N/A	N/A	N/A	N/A	0.0037	0.0021 J	< 0.06	N/A	N/A	N/A	N/A	N/A	N/A
Benzoic acid	N/A	N/A	N/A	N/A	N/A	0.11	< 0.35	< 0.6	N/A	N/A	N/A	N/A	N/A	N/A
Benzyl alcohol	N/A	N/A	N/A	N/A	N/A	< 0.014	< 0.014	< 0.3	N/A	N/A	N/A	N/A	N/A	N/A
Bis(2-ethylhexyl)phthalate	N/A	N/A	N/A	N/A	N/A	0.0076	< 0.21	< 0.06	N/A	N/A	N/A	N/A	N/A	N/A
Carbazole	N/A	N/A	N/A	N/A	N/A	0.0024	< 0.021	< 0.06	N/A	N/A	N/A	N/A	N/A	N/A
Chrysene	N/A	N/A	N/A	N/A	N/A	0.021	0.011	< 0.06	N/A	N/A	N/A	N/A	N/A	N/A
Dibenz(a,h)anthracene	N/A	N/A	N/A	N/A	N/A	0.0026	0.0023 J	< 0.06	N/A	N/A	N/A	N/A	N/A	N/A
Dibenzofuran	N/A	N/A	N/A	N/A	N/A	0.0064	0.003 J	< 0.06	N/A	N/A	N/A	N/A	N/A	N/A
Diethylphthalate	N/A	N/A	N/A	N/A	N/A	0.014 U	0.014 U	< 0.06	N/A	N/A	N/A	N/A	N/A	N/A
Di-n-butyl phthalate	N/A	N/A	N/A	N/A	N/A	0.028 U	0.028 U	< 0.06	N/A	N/A	N/A	N/A	N/A	N/A
Di-n-octyl phthalate	N/A	N/A	N/A	N/A	N/A	0.0039	< 0.028	< 0.06	N/A	N/A	N/A	N/A	N/A	N/A
Fluoranthene	N/A	N/A	N/A	N/A	N/A	0.013	0.01	< 0.06	N/A	N/A	N/A	N/A	N/A	N/A
Fluorene	N/A	N/A	N/A	N/A	N/A	0.0047	0.0052	< 0.06	N/A	N/A	N/A	N/A	N/A	N/A
Indeno(1,2,3-cd)pyrene	N/A	N/A	N/A	N/A	N/A	0.0053	0.0045 J	< 0.06	N/A	N/A	N/A	N/A	N/A	N/A
Isophorone	N/A	N/A	N/A	N/A	N/A	< 0.014	< 0.014	< 0.06	N/A	N/A	N/A	N/A	N/A	N/A
Naphthalene	N/A	N/A	N/A	N/A	N/A	0.0081	0.0045	< 0.06	N/A	N/A	N/A	N/A	N/A	N/A
Phenanthrene	N/A	N/A	N/A	N/A	N/A	0.015	0.0084	< 0.06	N/A	N/A	N/A	N/A	N/A	N/A
Phenol	N/A	N/A	N/A	N/A	N/A	0.0023	< 0.014	< 0.06	N/A	N/A	N/A	N/A	N/A	N/A
Pyrene	N/A	N/A	N/A	N/A	N/A	0.017	0.011	< 0.06	N/A	N/A	N/A	N/A	N/A	N/A
1,1,2,2,-Tetrachloroethane	N/A	N/A	N/A	N/A	N/A	< 0.0025	< 0.0026	< 0.0013	N/A	N/A	N/A	N/A	N/A	N/A
1,2,3-Trichlorobenzene	N/A	N/A	N/A	N/A	N/A	< 0.0025	< 0.0026	< 0.0063	N/A	N/A	N/A	N/A	N/A	N/A
1,2,4-Trichlorobenzene	N/A	N/A	N/A	N/A	N/A	< 0.0025	< 0.0026	< 0.0063	N/A	N/A	N/A	N/A	N/A	N/A
1,2,4-Trimethylbenzene	N/A	N/A	N/A	N/A	N/A	< 0.0012	< 0.0013	< 0.0013	N/A	N/A	N/A	N/A	N/A	N/A
1,2-Dibromo-3-Chloropropane	N/A	N/A	N/A	N/A	N/A	< 0.0025	< 0.0026	< 0.0063	N/A	N/A	N/A	N/A	N/A	N/A
1,2-Dichororbenzene	N/A	N/A	N/A	N/A	N/A	< 0.0012	< 0.0013	< 0.0013	N/A	N/A	N/A	N/A	N/A	N/A
1,3,5-Trimethylbenzene	N/A	N/A	N/A	N/A	N/A	< 0.0025	< 0.0026	< 0.0013	N/A	N/A	N/A	N/A	N/A	N/A
1,3-Dichlorobenzene	N/A	N/A	N/A	N/A	N/A	< 0.0012	< 0.0013	< 0.0013	N/A	N/A	N/A	N/A	N/A	N/A
1,4-Dichlorobenzene	N/A	N/A	N/A	N/A	N/A	< 0.0012	< 0.0013	< 0.0013	N/A	N/A	N/A	N/A	N/A	N/A
2-Chlorotoluene	N/A	N/A	N/A	N/A	N/A	< 0.0012	< 0.0013	< 0.0013	N/A	N/A	N/A	N/A	N/A	N/A
4-Chlorotoluene	N/A	N/A	N/A	N/A	N/A	< 0.0012	< 0.0013	< 0.0013	N/A	N/A	N/A	N/A	N/A	N/A
4-Isopropyltoluene	N/A	N/A	N/A	N/A	N/A	< 0.0012	< 0.0013	< 0.0013	N/A	N/A	N/A	N/A	N/A	N/A
Benzene	N/A	N/A	N/A	N/A	N/A	0.0012 U	0.0013 U	< 0.0013	N/A	N/A	N/A	N/A	N/A	N/A
Bromobenzene	N/A	N/A	N/A	N/A	N/A	< 0.0012	< 0.0013	< 0.0013	N/A	N/A	N/A	N/A	N/A	N/A
Chlorobenzene	N/A	N/A	N/A	N/A	N/A	0.0012 U	0.0013 U	< 0.0013	N/A	N/A	N/A	N/A	N/A	N/A
Chloromethane	N/A	N/A	N/A	N/A	N/A	< 0.0012	< 0.0013	< 0.0013	N/A	N/A	N/A	N/A	N/A	N/A
Ethylbenzene	N/A	N/A	N/A	N/A	N/A	< 0.0012	< 0.0013	< 0.0013	N/A	N/A	N/A	N/A	N/A	N/A
Hexachlorobutadiene	N/A	N/A	N/A	N/A	N/A	< 0.0012	< 0.0013	< 0.0063	N/A	N/A	N/A	N/A	N/A	N/A
Isopropylbenzene	N/A	N/A	N/A	N/A	N/A	< 0.0012	< 0.0013	< 0.0013	N/A	N/A	N/A	N/A	N/A	N/A
Methylene Chloride	N/A	N/A	N/A	N/A	N/A	< 0.0012	< 0.0013	< 0.0013	N/A	N/A	N/A	N/A	N/A	N/A
m-Xylene & p-Xylene	N/A	N/A	N/A	N/A	N/A	< 0.0025	0.00022 J	< 0.0013	N/A	N/A	N/A	N/A	N/A	N/A
Naphthalene	N/A	N/A	N/A	N/A	N/A	< 0.0062	< 0.0065	< 0.0063	N/A	N/A	N/A	N/A	N/A	N/A
n-Butylbenzene	N/A	N/A	N/A	N/A	N/A	< 0.0012	< 0.0013	< 0.0013	N/A	N/A	N/A	N/A	N/A	N/A
N-Propylbenzene	N/A	N/A	N/A	N/A	N/A	< 0.0012	< 0.0013	< 0.0013	N/A	N/A	N/A	N/A	N/A	N/A
o-Xylene	N/A	N/A	N/A	N/A	N/A	< 0.0012	0.00018 J	< 0.0013	N/A	N/A	N/A	N/A	N/A	N/A
sec-Butylbenzene	N/A	N/A	N/A	N/A	N/A	< 0.0012	< 0.0013	< 0.0013	N/A	N/A	N/A	N/A	N/A	N/A
Styrene	N/A	N/A	N/A	N/A	N/A	< 0.0012	< 0.0013	< 0.0013	N/A	N/A	N/A	N/A	N/A	N/A
tert-Butylbenzene	N/A	N/A	N/A	N/A	N/A	< 0.0012	< 0.0013	< 0.0013	N/A	N/A	N/A	N/A	N/A	N/A
Toluene	N/A	N/A	N/A	N/A	N/A	0.0012 U	0.0013 U	< 0.0013	N/A	N/A	N/A	N/A	N/A	N/A

ND - Not detected above the practical quantitation limit.
NSA - No standard available.
Bold - Detection is above media Screening Levels
J - Estimated value.
U - Not detected above the practical quantitation limit.
* MDL value

TABLE 4-1
Site COPCs & Maximum Detected Concentration

Near Surface Soil*		Sub-surface Soil		Sediment		Groundwater		Surface Water		Groundwater To Surface Water Impact	
COPC	Maximum Detected Concentration (mg/Kg)	COPC	Maximum Detected Concentration (mg/kg)	COPC	Maximum Detected Concentration (mg/kg)	COPC	Maximum Detected Concentration (µg/L)	COPC	Maximum Detected Concentration (µg/L)	COPC	Maximum Detected Concentration (µg/L)
Diesel	452	Diesel	17,000	Diesel	8,830	LNAPL**	Free Product	LNAPL***	Free Product	Arsenic	63
Heavy Oil	3,850	Heavy Oil	12,800	Heavy Oil	6980	Arsenic	63	Benzo[a]anthracene	0.0077	Thallium	1.4
Benzo(a)anthracene	0.046	Benzo(a)anthracene	0.36	Acenaphthene	1.9	Benzo(a)anthracene	0.0081	Chrysene	0.015	Benzo(a)anthracene	1.6
Benzo[a]pyrene	0.072	Benzo(a)pyrene	0.59	Anthracene	0.23	Benzo(a)pyrene	<0.019			Chrysene	3
Benzo(b)fluoranthene	0.097	Dibenzo(a,h)anthracene	0.245	Benzo(a)anthracene	0.48	Benzo(b)fluoranthene	<0.0096				
Dibenzo(a,h)anthracene	0.008	Indeno(1,2,3-cd)pyrene	0.277	Benzo(a)pyrene	0.0774	Benzo(g,h,i)perylene	0.0021				
		Naphthalene	38	Benzo(b)fluoranthene	0.143	Chrysene	0.011				
		1-Methylnapthalene	45	Benzo(k)fluoranthene	0.0467	1-methylnaphthalene	14				
		2-Methylnapthalene	78	Chrysene	1	2-Methylnaphthalene	6.7				
				Dibenzo(a,h)anthracene	0.037	Naphthalene	5.8				
				Fluorene	3.1						
				Fluoranthene	0.068						
				Indeno(1,2,3-cd)pyrene	0.0746						
				2-methylnaphthalene	0.47						
				Phenanthrene	5						
				Pyrene	2.3						

Maximum detected concentrations in EE/CA investigation samples.

*Surface soil is considered within the upper 5 feet.

**LNAPL in the groundwater had detections of diesel and heavy oil, PCBs, PAHs, and metals.

***LNAPL on the surface water had detections of diesel and heavy oil, PAHs, and metals.

TABLE 4-2
Physical and Chemical Properties of COPCs

Constituent or Fuel Fraction	Aqueous Solubility (mg/L)	Soil Organic Carbon-Water Partitioning Coefficient	Henry's Law Constant	Persistence	Distribution Coefficient (Log Kd)
Aliphatics					
EC > 10 - 12 (Diesel)	0.034	234,000	120.0	Medium	NA
EC > 12 - 16 (Diesel)	0.00076	5.37E+06	520.0	High	NA
EC > 16 - 21 (Oil)	0.0000013	9.55E+09	4,900	High	NA
EC > 21 - 34 (Oil)	1.5E-11	1.07E+10	100,000	High	NA
Aromatics					
EC > 10 - 12 (Diesel)	25.0	2,510	0.14	Medium	NA
EC > 12 - 16 (Diesel)	5.8	5,010	0.053	High	NA
EC > 16 - 21 (Oil)	0.51	15,800	0.013	High	NA
EC > 21 - 34 (Oil)	0.0066	126,000	6.70E-04	High	NA
Carcinogenic PAHs					
Benzo(a)anthracene	0.0094	1.38E+06	1.37E-04	High	NA
Benzo(b)fluoranthene	0.015	5.50E+05	4.55E-04	High	NA
Benzo(k)fluoranthene	0.0008	1.02E+06	3.40E-05	High	NA
Benzo(a)pyrene	0.00162	9.54E+05	4.63E-05	High	NA
Chrysene	0.0016	2.45E+05	3.88E-03	High	NA
Dibenzo(a,h)anthracene	0.000249	1.91E+06	6.03E-07	High	NA
Indeno(1,2,3-cd)pyrene	0.000022	3.47E+06	6.56E-05	High	NA
Non-Carcinogenic PAHs					
Acenaphthene	4.24	4.60E+03	6.36E-03	High	NA
Anthracene	0.043	1.86E+04	2.70E-03	High	NA
Fluoranthene	0.206	4.90E+04	6.60E-04	High	NA
Fluorene	1.98	7.30E+03	2.61E-03	High	NA
1-Methylnaphthalene	N/R	N/R	N/R	High	NA
2-Methylnaphthalene	25.4	4.37E+03	1.85E-02	High	NA
Naphthalene	31	1.20E+03	2.00E-02	High	NA
Phenanthrene	0.994	1.41E+04	5.40E-03	High	NA
Pyrene	0.135	6.46E+04	4.50E-04	High	NA
Polychlorinated Biphenyls					
Aroclor 1260	0.08	3.10E+05	1.85E-01	High	NA
Metals					
Antimony	Low	N/R	0	High	1.65
Arsenic	Low	N/R	0	High	1.4

Sources: Idaho DEQ Risk Evaluation Manual, "Physical-Chemical Properties For Developing IDTLs and RATLs", July 2004.
Washington State Department of Ecology, CLARC Database
N/R = not researched
NA = not available

TABLE 4-3
Vadose Zone Soil Sheen Test Results

Test Pit	Sample ID	Soil Zone	Odor	Sheen
TS-1	TS1-0 - 2.5	near surface	No	No
	TS1-2.5–5	near surface	Yes	Slight
	TS1- 7.5	vadose	Yes	Slight
	TS1-10	Vadose	Yes	Slight
TS-2	TS2-2.5	near surface	No	No
	TS2-5	near surface	No	No
	TS2-5 (dark)	near surface	No	No
	TS2-7.5-8.5	vadose	Yes	Slight
	TS2-10	vadose	Yes	Slight
TS-3	TS3-2.5	near surface	No	No
	TS3-5.0	near surface	No	Yes
	TS3-7.5	vadose	Yes	Yes
	TS3-10	vadose	Yes	Yes
TS-4	TS4-2.5	near surface	No	No
	TS4-5.0	near surface	No	No
	TS4-7.5	vadose	Yes	No
	TS4-10	vadose	Yes	Sheen
TS-5	GTS5-2.5	near surface	No	No
	GTS5-5.0	near surface	No	No
	GTS5-7.5	vadose	No	No
	GTS5-10.0	vadose	Slight	No
TS-6	GTS6-2.5	near surface	No	No
	GTS6-5.0	near surface	No	No
	GTS6-7.5	vadose	No	No
	GTS6-10.0	vadose	No	No
TP-1	GTP1-2.5	near surface	No	No
	GTP1-5.0	near surface	No	No
	GTP1-7.5	vadose	No	No
	GTP1-10	vadose	Yes	Yes
TP-2	GTP2-2.5	near surface	No	No
	GTP2-5.0	near surface	No	No
	GTP2-8.0	vadose	No	No
	GTP2-10	vadose	No	No
TP-3	GTP3-2.5	near surface	No	No
	GTP3-5.0	near surface	Organic only	No
	GTP3-8.5	vadose	No	No
	GTP3-11	vadose	No	No
TP-4	GTP4-2.5	near surface	No	No
	GTP4-5.0	near surface	No	No
	GTP4-8.0 (Bag	vadose	No	No
	GTP4-8.0 (Bag	vadose	No	No
TP-5	GTP5-2.5	near surface	No	No
	GTP5-5.0	near surface	No	No
	GTP5-7.5	vadose	No	No
	GTP5-10.5	vadose	No	No
	GTP5-11.0	vadose	Slight	No
TP-6	GTP6-2.5	near surface	No	Slight
	GTP6-5.0	near surface	Slight	Slight
	GTP6-7.5	vadose	Organic only	No
	GTP6-10.0	vadose	Organic only	No
TP-7	GTP7-2.5	near surface	No	No
	GTP7-5.0	near surface	No	No
	GTP7-7.5	vadose	No	No
	GTP7-10	vadose	No	No
TP-8	GTP8-2.5	near surface	No	No
	GTP8-5.0	near surface	Organic only	No
	GTP8-7.5	vadose	Organic only	No
	GTP8-10	vadose	No	No

TABLE 5-1
Sediment PAH Screening

Type	Analytes	Method	EPA Freshwater Sed. Screening Benchmarks	Sample ID / Collection Date / Units	G-RS1SED-0-090709 9/7/2009	G-RS1SED-4-090709 9/7/2009	G-RS2SED-0-090709 9/7/2009	G-RS2SED-3-090709 9/7/2009	G-RS3SED-0-090709 9/7/2009	G-RS3SED-4-090709 9/7/2009	G-RS4SED-0-090709 9/7/2009	G-RS4SED-4-090709 9/7/2009
TPH	Diesel Range Organics	NWTPH-Dx	NSA	mg/kg dry	ND	66.3	74.3	62.4	194	403	8830	39.6
	Heavy Oils	NWTPH-Dx	NSA	mg/kg dry	89	464	336	272	492	588	6980	164
Carcinogenic PAH	Benzo(a)anthracene	8270 SIM	0.108	mg/kg dry	0.00494 UJ	0.0085 R	0.00498 UJ	0.00841 R	0.00471 R	**0.0709 J**	0.00947 R	< 0.00477
	Benzo(a)pyrene	8270 SIM	0.150	mg/kg dry	0.00494 UJ	0.0085 R	0.00498 UJ	0.00841 R	0.0101 J	**0.0333 J**	**0.0455 J**	< 0.00477
	Benzo(b)fluoranthene	8270 SIM	0.027	mg/kg dry	0.0155 J	0.0147 J	0.00498 UJ	0.00841 R	0.00471 R	**0.0388 J**	0.00947 R	< 0.00477
	Benzo(k)fluoranthene	8270 SIM	0.240	mg/kg dry	0.00494 UJ	0.0085 R	0.00498 UJ	0.00841 R	0.00471 R	0.00831 R	**0.0467 J**	< 0.00477
	Chrysene	8270 SIM	0.166	mg/kg dry	0.00941 J	0.00907 J	0.00498 UJ	0.00841 R	0.0101 J	**0.129 J**	**0.0455 J**	< 0.00477
	Dibenzo(a,h)anthracene	8270 SIM	0.033	mg/kg dry	0.00494 UJ	**0.00907 J**	**0.00745 J**	**0.00897 J**	**0.0151 J**	**0.0111 J**	**0.0152 J**	**0.00796**
	Indeno(1,2,3-cd)pyrene	8270 SIM	0.017	mg/kg dry	0.00494 UJ	0.0113 J	0.00881 J	0.00841 R	**0.0182 J**	0.0144 J	0.0114 J	0.00849
Non- Carcinogenic PAH	Acenaphthene	8270 SIM	0.0067	mg/kg dry	0.00494 UJ	0.0085 UJ	0.00498 UJ	0.00841 UJ	**0.0101**	**0.1030**	< 0.00947	< 0.00477
	Acenaphthylene	8270 SIM	0.0059	mg/kg dry	0.00494 UJ	0.0085 UJ	0.00498 UJ	0.00841 UJ	<0.00471	< 0.00831	< 0.00947	< 0.00477
	Anthracene	8270 SIM	0.0572	mg/kg dry	0.00494 UJ	0.0085 UJ	0.00498 UJ	0.00841 UJ	0.00817	**0.1200**	< 0.00947	< 0.00477
	Benzo(g,h,i)perylene	8270 SIM	0.17	mg/kg dry	0.00672 J	0.0193 J	0.0115 J	0.0112 J	0.0277 J	0.0299 J	0.0101 J	0.0101
	Fluoranthene	8270 SIM	0.423	mg/kg dry	0.00874 J	0.0085 UJ	0.00498 UJ	0.00841 UJ	<0.00471	**0.0521**	0.0189 J	< 0.00477
	Fluorene	8270 SIM	0.0774	mg/kg dry	0.00494 UJ	0.0085 UJ	0.00498 UJ	0.00841 UJ	**0.0151**	**0.0998**	< 0.00947	< 0.00477
	Naphthalene	8270 SIM	0.176	mg/kg dry	0.00494 UJ	0.0085 UJ	0.00498 UJ	0.00841 UJ	<0.00471	< 0.00831	< 0.00947	< 0.00477
	Phenanthrene	8270 SIM	0.204	mg/kg dry	0.00494 UJ	0.0085 UJ	0.00498 UJ	0.00841 UJ	**0.0214**	**0.3540**	**0.0202 J**	< 0.00477
	Pyrene	8270 SIM	0.195	mg/kg dry	0.0087	0.0204 J	0.00498 UJ	0.00841 R	0.027 J	**0.44 J**	**0.096 J**	0.00636
	1-Methylnaphthalene	8270 SIM	NSA	mg/kg dry	0.00494 UJ	0.0085 UJ	0.00498 UJ	0.00841 UJ	0.0176	0.0964	< 0.00947	< 0.00477
	2-Methylnaphthalene	8270 SIM	0.02	mg/kg dry	0.00494 UJ	0.0085 UJ	0.00498 UJ	0.00841 UJ	<0.00471	< 0.00831	< 0.00947	< 0.00477
Semivolatiles	1-Methylnaphthalene	8270C	NSA	mg/kg dry	< 0.043	0.0086 J	0.0098	0.0056	0.05	0.11	5	0.0033 J
	2-Methylnaphthalene	8270C	0.020	mg/kg dry	0.0069 J	**0.021 J**	0.019	0.011	0.0055 J	0.016 J	**0.47**	0.0048 J
	Acenaphthene	8270C	0.0067	mg/kg dry	< 0.029	< 0.024	0.0016 J	< 0.0025	**0.032**	**0.18**	**1.9**	< 0.023
	Acenaphthylene	8270C	0.0059	mg/kg dry	< 0.029	< 0.024	0.0025 J	0.0046	< 0.027	< 0.023	< 0.024	< 0.023
	Anthracene	8270C	0.057	mg/kg dry	0.0078 J	0.014 J	0.0034	0.0057	0.017 J	**0.1**	**0.23**	< 0.023
	Benzo(a)anthracene	8270C	0.11	mg/kg dry	0.04	0.012 J	0.0034 J	0.0029 J	< 0.034	0.1	**0.48**	< 0.028
	Benzo(a)pyrene	8270C	0.15	mg/kg dry	0.0066 J	< 0.036	0.0052	0.0064	< 0.041	0.097	< 0.035	< 0.034
	Benzo(b)fluoranthene	8270C	0.027	mg/kg dry	< 0.029	< 0.024	0.0069	0.013	< 0.027	**0.078**	< 0.024	< 0.023
	Benzo(g,h,i)perylene	8270C	0.17	mg/kg dry	< 0.036	0.022 J	0.0074	0.015	0.028 J	0.038	0.12	< 0.028
	Benzo(k)fluoranthene	8270C	0.24	mg/kg dry	< 0.036	< 0.030	0.0016 J	0.0015 J	< 0.034	0.027 J	< 0.030	< 0.028
	Chrysene	8270C	0.166	mg/kg dry	0.0098 J	0.029 J	0.0083	0.016	< 0.034	0.29	**1**	0.0035 J
	Dibenzo(a,h)anthracene	8270C	0.033	mg/kg dry	< 0.057	< 0.047	0.0017 J	< 0.0051	< 0.055	< 0.047	< 0.047	< 0.046
	Fluoranthene	8270C	0.42	mg/kg dry	0.016 J	0.04	0.0065	0.0045	< 0.027	0.15	**0.68**	0.0065 J
	Fluorene	8270C	0.077	mg/kg dry	< 0.029	< 0.024	< 0.0028	< 0.0025	0.059	**0.17**	**3.1**	< 0.023
	Indeno(1,2,3-cd)pyrene	8270C	0.017	mg/kg dry	**0.024 J**	**0.035 J**	0.0043 J	0.0064	< 0.055	**0.025 J**	< 0.047	< 0.046
	Naphthalene	8270C	0.18	mg/kg dry	< 0.029	0.019 J	0.0068	0.005	< 0.027	< 0.023	< 0.024	< 0.023
	Phenanthrene	8270C	0.20	mg/kg dry	0.017 J	0.04	0.01	0.01	0.078	**0.48**	**5**	< 0.023
	Pyrene	8270C	0.20	mg/kg dry	0.013 J	0.047	0.01	0.013	0.092	**0.54**	**2.3**	0.023
	Total PAH		**1.61**	mg/kg dry	0.28932	0.38037			0.503	**2.4551**	**20.4348**	

Notes:

Bold - Detection is above media Screening Levels.

Yellow highlighting indicates detections exceeding EPA Freshwater Sediment Screening Benchmarks.

NSA - No screening level available.

" < " - The analyte is not detected above the reporting quantitation limit.

U - Analyte not detected above the reported amount as a result of validation rules.

J - The analyte is positively idenitifed. However, the result is an estimated value.

UJ - The analyte was not detected above the reporting quantitation limit. However the reporting limit is approximate.

R - The data is rejected due to a deficiency in quality control criteria.

Total PAH concentration calculated using the highest concentration detected for each analyte in each sample. Half of the detection limit was used for calculating non-detect values.

TABLE 5-1
Sediment PAH Screening

Type	Analytes	Method	EPA Freshwater Sed. Screening Benchmarks	Sample ID / Collection Date / Units	G-RS-5SED-0-090809 9/8/2009	G-RS5SED-4-090709 9/7/2009	G-RS6SED-0-090709 9/7/2009	G-RS6SED-3-090709 9/7/2009	G-RS7SED-0-090709 9/7/2009	G-RS7SED-4-090709 9/7/2009	G-RS8SED-0-090709 9/7/2009	G-RS8SED-3-090709 9/7/2009
TPH	Diesel Range Organics	NWTPH-Dx	NSA	mg/kg dry	24.3	73.1	22.4	25.3	< 14.9	< 11.8	< 14.7	< 12.5
	Heavy Oils	NWTPH-Dx	NSA	mg/kg dry	112	178	140	126	< 37.3	< 29.6	< 36.7	< 31.3
Carcinogenic PAH	Benzo(a)anthracene	8270 SIM	0.108	mg/kg dry	0.00586	**0.0326**	< 0.00462	< 0.00499	0.00497 UJ	0.00473 UJ	0.00489 UJ	0.00417 UJ
	Benzo(a)pyrene	8270 SIM	0.150	mg/kg dry	0.00521	**0.0774**	< 0.00462	0.00499 R	0.00497 UJ	0.00473 UJ	0.00489 UJ	0.00417 UJ
	Benzo(b)fluoranthene	8270 SIM	0.027	mg/kg dry	< 0.00488	**0.143**	< 0.00462	0.00499 R	0.0053 J	0.00473 UJ	0.00489 UJ	0.00417 UJ
	Benzo(k)fluoranthene	8270 SIM	0.240	mg/kg dry	0.01040	< 0.00498	< 0.00462	0.00499 R	0.00497 UJ	0.00473 UJ	0.00489 UJ	0.00417 UJ
	Chrysene	8270 SIM	0.166	mg/kg dry	0.00976	**0.0625**	< 0.00462	< 0.00499	0.00497 UJ	0.00473 UJ	0.00489 UJ	0.00417 UJ
	Dibenzo(a,h)anthracene	8270 SIM	0.033	mg/kg dry	< 0.00488	**0.037**	< 0.00462	0.00499 R	0.00497 UJ	0.00473 UJ	0.00489 UJ	0.00417 UJ
	Indeno(1,2,3-cd)pyrene	8270 SIM	0.017	mg/kg dry	< 0.00488	**0.0746**	< 0.00462	0.00499 R	0.00497 UJ	0.00473 UJ	0.00489 UJ	0.00417 UJ
Non- Carcinogenic PAH	Acenaphthene	8270 SIM	0.0067	mg/kg dry	< 0.00488	**0.0453**	< 0.00462	< 0.00499	0.00497 UJ	0.00473 UJ	0.00489 UJ	0.00417 UJ
	Acenaphthylene	8270 SIM	0.0059	mg/kg dry	< 0.00488	< 0.00498	< 0.00462	< 0.00499	0.00497 UJ	0.00473 UJ	0.00489 UJ	0.00417 UJ
	Anthracene	8270 SIM	0.0572	mg/kg dry	< 0.00488	**0.0122**	< 0.00462	< 0.00499	0.00497 UJ	0.00473 UJ	0.00489 UJ	0.00417 UJ
	Benzo(g,h,i)perylene	8270 SIM	0.17	mg/kg dry	0.00586	0.106	< 0.00462	0.00499 R	0.00497 UJ	0.00473 UJ	0.00489 UJ	0.00417 UJ
	Fluoranthene	8270 SIM	0.423	mg/kg dry	0.00716	0.0293	0.00616	< 0.00499	0.0139 J	0.00473 UJ	0.00489 UJ	0.00417 UJ
	Fluorene	8270 SIM	0.0774	mg/kg dry	< 0.00488	**0.084**	< 0.00462	< 0.00499	0.00497 UJ	0.00473 UJ	0.00489 UJ	0.00417 UJ
	Naphthalene	8270 SIM	0.176	mg/kg dry	< 0.00488	0.0122	< 0.00462	< 0.00499	0.00497 UJ	0.00473 UJ	0.00489 UJ	0.00417 UJ
	Phenanthrene	8270 SIM	0.204	mg/kg dry	< 0.00488	**0.0802**	< 0.00462	< 0.00499	0.00497 UJ	0.00473 UJ	0.00489 UJ	0.00417 UJ
	Pyrene	8270 SIM	0.195	mg/kg dry	0.01430	**0.129**	0.00555	< 0.00499	0.0119 J	0.00473 UJ	0.00489 UJ	0.00417 UJ
	1-Methylnaphthalene	8270 SIM	NSA	mg/kg dry	< 0.00488	0.101	< 0.00462	< 0.00499	0.00497 UJ	0.00473 UJ	0.00489 UJ	0.00417 UJ
	2-Methylnaphthalene	8270 SIM	0.02	mg/kg dry	< 0.00488	< 0.00498	< 0.00462	< 0.00499	0.00497 UJ	0.00473 UJ	0.00489 UJ	0.00417 UJ
Semivolatiles	1-Methylnaphthalene	8270C	NSA	mg/kg dry	0.0063	0.087	0.0015 J	0.00097 J	< 0.0043	< 0.0036	< 0.0044	0.00027 J
	2-Methylnaphthalene	8270C	0.020	mg/kg dry	0.013	< 0.0024	0.0028	0.002 J	0.00044 J	0.00035 J	< 0.0029	0.00071 J
	Acenaphthene	8270C	0.0067	mg/kg dry	0.0031	**0.041**	< 0.0026	< 0.0029	< 0.0029	< 0.0024	< 0.0029	< 0.0023
	Acenaphthylene	8270C	0.0059	mg/kg dry	0.0025	< 0.0024	0.00098 J	< 0.0029	< 0.0029	< 0.0024	< 0.0029	< 0.0023
	Anthracene	8270C	0.057	mg/kg dry	0.0036	0.01	0.002 J	0.00081 J	0.0012 J	0.00036 J	< 0.0029	< 0.0023
	Benzo(a)anthracene	8270C	0.11	mg/kg dry	0.0089	0.0059	0.0058	0.00042 J	0.0022 J	0.00066 J	0.00087 J	< 0.0029
	Benzo(a)pyrene	8270C	0.15	mg/kg dry	0.0074	0.0069	0.0062	0.00098 J	< 0.0043	< 0.0036	< 0.0044	< 0.0035
	Benzo(b)fluoranthene	8270C	0.027	mg/kg dry	0.018	0.0052	0.01	0.0015 J	0.0024 J	< 0.0024	< 0.0029	< 0.0023
	Benzo(g,h,i)perylene	8270C	0.17	mg/kg dry	0.009	0.005	0.0049	0.0023 J	< 0.0036	< 0.0030	< 0.0037	< 0.0029
	Benzo(k)fluoranthene	8270C	0.24	mg/kg dry	0.0037	< 0.0030	0.0022 J	0.00061 J	< 0.0036	< 0.0030	< 0.0037	< 0.0029
	Chrysene	8270C	0.166	mg/kg dry	0.021	0.013	0.0085	0.0033 J	0.0054	< 0.0030	< 0.0037	< 0.0029
	Dibenzo(a,h)anthracene	8270C	0.033	mg/kg dry	0.0026	< 0.0048	0.0017 J	< 0.0059	< 0.0058	< 0.0048	< 0.0059	< 0.0047
	Fluoranthene	8270C	0.42	mg/kg dry	0.013	0.0078	0.014	0.0016 J	0.014	0.00036 J	0.0011 J	0.00066 J
	Fluorene	8270C	0.077	mg/kg dry	0.0047	**0.08**	< 0.0026	< 0.0029	< 0.0029	< 0.0024	< 0.0029	< 0.0023
	Indeno(1,2,3-cd)pyrene	8270C	0.017	mg/kg dry	0.0053	0.0023 J	0.004 J	0.0016 J	< 0.0058	< 0.0048	< 0.0059	< 0.0047
	Naphthalene	8270C	0.18	mg/kg dry	0.0081	0.013	0.0016 J	< 0.0029	< 0.0029	< 0.0024	< 0.0029	0.00048 J
	Phenanthrene	8270C	0.20	mg/kg dry	0.015	0.08	0.0043	0.0014 J	0.0081	0.00053 J	< 0.0029	< 0.0023
	Pyrene	8270C	0.20	mg/kg dry	0.017	0.027	0.013	< 0.0029	0.012	0.00072 J	0.001 J	0.00078 J
	Total PAH		**1.61**	mg/kg dry		1.03457						

Notes:

Bold - Detection is above media Screening Levels.
Yellow highlighting indicates detections exceeding EPA Freshwater Sediment Screening E
NSA - No screening level available.
" < " - The analyte is not detected above the reporting quantitation limit.
U - Analyte not detected above the reported amount as a result of validation rules.
J - The analyte is positively idenitifed. However, the result is an estimated value.
UJ - The analyte was not detected above the reporting quantitation limit. However the repo
R - The data is rejected due to a deficiency in quality control criteria.
Total PAH concentration calculated using the highest concentration detected for each anal

TABLE 7-1
Identification and Screening of Remediation Technologies
Potlatch Avery Landing Site

General Response Actions	Options	Process Description	Effectiveness	Implementability	Relative Cost	Retain for Further Consideration	Reasons for Screening Decision
Institutional Controls and Monitoring	Site Access Restrictions	Prevention of access to affected area by fencing and warning signs.	Effective at limiting exposure by warning potential intruders of hazards.	Implementable.	Low	Yes	Effective at limiting exposures and easily implementable at low cost.
	Land Use Restrictions	Controls, including deed restrictions, to limit or prevent activity that would lead to exposure, or damage to remedy, i.e., restrictions on use of site groundwater for drinking water or activities that would damage a cap.	Effective at eliminating risk due to exposure to constituents of concern.	Implementable	Low	Yes	Effective at limiting exposures and easily implementable at low cost. However, deed restrictions are not implementable.
	Alternate Water Supply	Supply of an alternate source of drinking water in cases where existing or future supply is impacted by site constituents of concern.	Effective at eliminating risk from exposure to constituents of concern in drinking water.	Providing drinking water via bottled water or alternate piped source has poor implementability as a permanent remedy.	Med to High	No	No on-site residents using site groundwater.
Monitored Natural Attenuation	Monitored Natural Attenuation	Allow natural physical and biological processes to gradually remove site contamination.	LNAPL thickness has decreased over time; mobile oil from soil contamination will slowly create new LNAPL for some time; some biological degradation may be occurring, but the high-molecular weight compounds will degrade very slowly or not at all.	Implementable.	Low	Yes, as part of LNAPL containment & recovery	Will occur naturally as part of LNAPL containment and recovery.
	Monitoring	Environmental monitoring (i.e., groundwater) to measure the effectiveness of remedy.	Effective at ensuring that the remedy continues to be protective.	Implementable.	Med	Yes	Required component of any remedy where contamination remains above cleanup levels after completion of remedy.
Containment	Capping	Soil Cap. Minimum of 2 feet of clean fill.	Effective at preventing direct contact with contaminated soil.	Readily implemented using standard design and construction techniques. Periodic maintenance required.	Low	Yes	Proven and effective technology
		Paving. Asphalt or concrete pavement. Paving generally done only for developed areas where there is a need to combine containment with continued industrial use.	Effective at limiting groundwater infiltration through contaminated soil.	Readily implemented using standard design and construction techniques. High maintenance requirements under site conditions.	Med	No	Reducing infiltration would not significantly aid in meeting site RAOs. Retained technologies are more effective and/or less costly.
		Low-Permeability Cap (multiple cap types possible).	Effective at limiting groundwater infiltration through contaminated soil.	Readily implemented using standard design and construction techniques. Periodic maintenance required.	High	No	Reducing infiltration would not significantly aid in meeting site RAOs. Retained technologies are more effective and/or less costly.
	Surface Water Controls	Stormwater drainage controls	Effective at minimizing erosion of soil cover.	Readily implemented using standard design and construction techniques. Periodic maintenance required.	Low	Yes, as part of soil cover	Proven and effective technology.
	Vertical Barriers for LNAPL	Impermeable barrier to prevent LNAPL from entering surface water, used in conjunction with LNAPL removal.	Can be highly effective at keeping LNAPL from entering the river. Use in combination with LNAPL removal.	Can be implemented using standard design and construction techniques. Periodic maintenance required.	Mod	Yes	Proven and effective technology.
	Vertical Barriers for Groundwater Containment	Slurry wall or similar impermeable wall around all contaminated site areas.	Effective	Implementable, but difficult excavation in site soils.	High	No	Contaminated groundwater not measurably affecting the river or other off-site receptors.
	Hydraulic Containment	Groundwater pumping	Potentially effective	Difficult to implement because of hydrologic connection to river	High	No	Contaminated groundwater not measurably affecting the river or other off-site receptors.

TABLE 7-1
Identification and Screening of Remediation Technologies
Potlatch Avery Landing Site

General Response Actions	Options	Process Description	Effectiveness	Implementability	Relative Cost	Retain for Further Consideration	Reasons for Screening Decision
Removal	LNAPL Removal	Intercept and skim oil in conjunction with LNAPL barrier (see containment)		Readily implemented.	High	Yes	Necessary component of LNAPL interception.
	Excavation	Standard excavating equipment such as backhoes, trenchers, bulldozers, and scrapers could be used.	Effective	Coarse gravels and large concrete obstacles will make excavation difficult	Low	Yes	Necessary in conjunction with LNAPL interception/collection systems and ex-situ soil washing.
Ex-Situ Treatment - Soil	Soil Washing	Combination of size segregation and removal of oil with water (see Section 9 for description).	Proven highly effective for site soils (see Treatability Study, Appendix F). Residual filter cake (~5% of treated volume) would require on-site treatment or off-site disposal.	Implementable	Mod to High	Yes	Most cost-effective soil treatment technology under site conditions.
	Landfarm (on-site)	Spread soil on-site, add nutrients, till soil.	Proven technology for petroleum hydrocarbons, but treatment could take a long time for some high-molecular-weight hydrocarbons.	Readily implemented	Low	Yes	Could be appropriate for treatment residuals.
	Ex-Situ Thermal Desorption	Hydrocarbons volatilized in rotary kiln or similar equipment. Offgas incinerated to destroy volatilized hydrocarbons.	Highly effective for petroleum compounds.	Could not treat oversize particles, which are prevalent at this site.	Very High	No	Soil washing is preferred considering effectiveness, implementability, and cost.
Ex-Situ Treatment - Groundwater	Various	Varies	Technologies that would be effective for this site (e.g., carbon adsorption) are available.	Implementable	Mod to High	No	Dissolved contaminants in groundwater not measurably affecting the river or other off-site receptors. On-site groundwater contamination sufficiently managed by institutional controls.
In-Situ Treatment - Soil	Soil flushing	Use steam or solvents to mobilize and then recover contaminants. Mobilized contaminants would be recovered via LNAPL recovery and groundwater treatment.	Uncertain effectiveness (pilot study would be required). Solvents could present environmental risks.	Very difficult to control under site conditions (e.g., river affecting hydrology)	High	No	Costly, yet may not be effective under site conditions.
	In-situ biodegradation	Use natural biological processes to degrade hydrocarbons on soil.	Long, cold winters limit treatment effectiveness. Not effective on high-molecular-weight hydrocarbons.	Implementable	Mod	No	Poor effectiveness and long treatment time.
	In-situ chemical oxidation	Inject chemical oxidants (e.g., Fenton's reagent) to degrade hydrocarbons on soil.	Effective with sufficient chemical oxidant.	Difficult because large quantities of chemical would be required to be effective.	Very high	No	Soil washing would be as effective, more reliable, and easier to implement.
	In-situ thermal desorption	Heat soil in place electrically to volatilize hydrocarbons. Recover hydrocarbons by LNAPL recovery and soil vapor extraction.	Poor effectiveness at this site. Not practical to get in-situ temperatures high enough to volatilize high-molecular-weight compounds.	Not implementable because high electrical demand exceeds available capacity.	High	No	Not implementable, costly, and less effective than soil washing.
In-Situ Treatment - Groundwater	In-situ biodegradation	Use natural biological processes to degrade dissolved hydrocarbons, but poorly effective for LNAPL.	Unlikely to be effective without source removal.	Implementable	Mod to High	No	Contaminated groundwater not measurably affecting the river or other off-site receptors. Ineffective for LNAPL. On-site groundwater contamination sufficiently managed by institutional controls.
	In-situ chemical oxidation	Inject chemical oxidants (e.g., Fenton's reagent) to degrade dissolved hydrocarbons.	Unlikely to be effective without source removal. Requires excessive chemical quantities for LNAPL.	Implementable, but difficult to distribute with fluctuating water tables	High to Vey High	No	Contaminated groundwater not measurably affecting the river or other off-site receptors. On-site groundwater contamination sufficiently managed by institutional controls.
Disposal	On-site	Placement under soil cover	See soil cover containment	Implementable	Low	Yes	Appropriate disposition for some excavated materials.
	Off-site	Permitted landfill	Effective containment	Implementable for small quantities; traffic difficulties for large quantities	High	Yes	Could be appropriate for treatment residuals.

TABLE 10-1
Summary of Estimated Alternative Costs

Alternative		Estimated Costs (millions) [a]		
		Capital	O&M [b]	Total
A	No Further Action	$0.0	$0.7	$0.7
B	Institutional Controls	$0.03	$0.7	$0.7
C-1	Focused Improvements in Containment and LNAPL Recovery Using a River Wall	$1.4	$1.2	$2.5
C-2	Focused Improvements in Containment and LNAPL Recovery Using a Trench	$1.2	$1.0	$2.2
D	Complete Replacement of the Containment and LNAPL Recovery System	$2.5	$1.0	$3.5
E	Complete Containment/Recovery Replacement and Hot-Spot Treatment	$4.3	$0.8	$5.1
F	Complete Containment/Recovery Replacement and Major Source Treatment	$5.9	$0.3	$6.2
G	Treatment of Entire LNAPL Plume	$8.2	$0.0	$8.2

[a] Costs are for early 2010.

[b] Net present value of both operating and maintenance costs during remedial action and post-remediation maintenance and monitoring.

TABLE 10-2
Estimated Cost for Alternative A: No Further Action

Item	Quantity	Units	Unit Cost	Cost [a]	Notes
CAPITAL COSTS					
No further construction				$ -	
TOTAL CAPITAL COSTS				**$ -**	
Operations, Maintenance, & Monitoring (O&M)					Present value calculation, 3% net interest.
LNAPL collection & disposal (existing system)	50	yr	$ 5,000	$ 129,000	
Site inspection	50	yr	$ 2,000	$ 51,000	
Maintenance	50	yr	$ -	$ -	
Groundwater monitoring	50	yr	$ 10,000	$ 257,000	
Evaluation and reporting	50	yr	$ 5,000	$ 129,000	
Subtotal			$ 22,000	$ 566,000	
Contingency			25%	$ 142,000	
NET PRESENT VALUE O&M [b]				**$ 708,000**	
TOTAL ALTERNATIVE COST				**$ 708,000**	Net present value [b]

[a] Costs are for early 2010. Cost include overhead & profit for first-level contractor, but not for general contractor.

[b] The sum of capital and operating costs and the net present value of the post-closure care costs.

TABLE 10-3
Estimated Cost for Alternative B: Institutional Controls

Item	Quantity	Units	Unit Cost	Cost [a]	Notes
CAPITAL COSTS					
No further construction				$ -	
Subtotal				$ -	
Institutional Controls				$ 25,000	
TOTAL CAPITAL COSTS				**$ 25,000**	
Operations, Maintenance, & Monitoring (O&M)					Present value calculation, 3% net interest.
LNAPL collection & disposal (existing system)	50	yr	$ 5,000	$ 129,000	
Site inspection	50	yr	$ 2,000	$ 51,000	
Maintenance	50	yr	$ -	$ -	
Groundwater monitoring	50	yr	$ 10,000	$ 257,000	
Evaluation and reporting	50	yr	$ 5,000	$ 129,000	
Subtotal			$ 22,000	$ 566,000	
Contingency			25%	$ 142,000	
NET PRESENT VALUE O&M [b]				**$ 708,000**	
TOTAL ALTERNATIVE COST				**$ 733,000**	Net present value [b]

[a] Costs are for early 2010. Cost include overhead & profit for first-level contractor, but not for general contractor.

[b] The sum of capital and operating costs and the net present value of the post-closure care costs.

TABLE 10-4
Estimated Cost for Alternative C-1: Focused Improvements in Containment and LNAPL Recovery Using a River Wall

Item	Quantity	Units	Unit Cost	Cost [a]	Notes
CAPITAL COSTS					
Mob/demob, site prep, temp. facilities, site cleanup				$ 139,000	
Sediment control measures during construction				$ 30,000	Silt curtains/fences
Remove, clean, and place riprap	350	lf	$ 188	$ 65,937	
Off-site disposal of contaminated materials	68	cy	$ 107	$ 7,208	
Below-grade containment wall	350	lf	$ 616	$ 215,444	
Above-grade concrete wall	350	lf	$ 621	$ 217,432	
Downstream containment wall	40	lf	$ 1,279	$ 51,171	
LNAPL collection system in ditch	350	lf	$ 100	$ 35,000	
Topsoil	1,613	cy	$ 40	$ 64,533	6" in disturbed areas
Reseeding	2.0	acre	$ 2,500	$ 5,000	
Subtotal				$ 830,726	
Institutional Controls & Permitting				$ 60,000	
Contractor overhead and profit			0%	$ -	
Design				$ 100,000	
Construction Oversight	4	mo	$ 30,000	$ 120,000	
Removal Completion Report				$ 75,000	
Contingency			20%	$ 166,000	
TOTAL CAPITAL COSTS				**$ 1,352,000**	
Operations, Maintenance, & Monitoring (O&M)					Present value calculation, 3% net interest.
LNAPL collection & disposal	50	yr	$ 7,500	$ 193,000	
Site inspection	50	yr	$ 2,000	$ 51,000	
Maintenance (soil cover & concrete wall)	50	yr	$ 7,000	$ 180,000	Allowance ($2 k/ yr cover; $5 k/yr wall)
Groundwater monitoring	50	yr	$ 10,000	$ 257,000	
Evaluation and reporting	50	yr	$ 10,000	$ 257,000	
Subtotal			$ 36,500	$ 938,000	
Contingency			25%	$ 235,000	
NET PRESENT VALUE O&M [b]				**$ 1,173,000**	
TOTAL ALTERNATIVE COST				**$ 2,525,000**	Net present value [b]

[a] Costs are for early 2010. Cost include overhead & profit for first-level contractor, but not for general contractor.

[b] The sum of capital and operating costs and the net present value of the post-closure care costs.

TABLE 10-5
Estimated Cost for Alternative C-2: Focused Improvements in Containment and LNAPL Recovery Using a Trench

Item	Quantity	Units	Unit Cost	Cost [a]	Notes
CAPITAL COSTS					
Mob/demob, site prep, temp. facilities, site cleanup				$ 139,000	
Cofferdam and other river protection				$ 50,000	
Remove and stockpile clean riprap	702	cy	$ 14.00	$ 9,824	
Remove and stockpile clean soil	5,976	cy	$ 9.00	$ 53,780	
On-site placement of contaminated soil				$ 27,817	"disposal" area
Off-site disposal of contaminated materials	15	cy	$ 81.52	$ 1,190	
Place clean soil	5,235	cy	$ 10.50	$ 54,971	
Remove & clean riprap and foundations				$ 13,795	
Barrier / collector trench	350	lf	$ 571	$ 199,850	
Replace riprap				$ 65,754	
Topsoil	465	cy	$ 40	$ 18,589	6" over disturbed area
Reseeding	2.6	acre	$ 2,500	$ 6,440	
Subtotal				$ 641,011	
Institutional Controls & Permitting				$ 60,000	
Contractor overhead and profit			0%	$ -	
Design				$ 150,000	
Construction Oversight	4	mo	$ 30,000	$ 120,000	
Removal Completion Report				$ 100,000	
Contingency			20%	$ 128,000	
TOTAL CAPITAL COSTS				**$ 1,199,000**	
Operations, Maintenance, & Monitoring (O&M)					Present value calculation, 3% net interest.
LNAPL collection & disposal	50	yr	$ 7,500	$ 193,000	
Site inspection	50	yr	$ 2,000	$ 51,000	
Maintenance (soil cover & LNAPL trench)	50	yr	$ 3,000	$ 77,000	Allowance
Groundwater monitoring	50	yr	$ 10,000	$ 257,000	
Evaluation and reporting	50	yr	$ 10,000	$ 257,000	
Subtotal			$ 32,500	$ 835,000	
Contingency			25%	$ 209,000	
NET PRESENT VALUE O&M [b]				**$ 1,044,000**	
TOTAL ALTERNATIVE COST				**$ 2,243,000**	Net present value [b]

[a] Costs are for early 2010. Cost include overhead & profit for first-level contractor, but not for general contractor.

[b] The sum of capital and operating costs and the net present value of the post-closure care costs.

Golder Associates

TABLE 10-6
Estimated Cost for Alternative D: Complete Replacement of the Containment and LNAPL Recovery System

Item	Quantity	Units	Unit Cost	Cost [a]	Notes
CAPITAL COSTS					
Mob/demob, site prep, temp. facilities, site cleanup				$ 139,000	
Cofferdam and other river protection				$ 100,000	
Remove and stockpile clean riprap	2,229	cy	$ 14.00	$ 31,212	
Remove and stockpile clean soil	18,985	cy	$ 9.00	$ 170,868	
On-site placement of contaminated soil				$ 88,378	"disposal" area
Off-site disposal of contaminated materials	46	cy	$ 81.52	$ 3,782	
Place clean soil	16,633	cy	$ 10.50	$ 174,650	
Remove & clean riprap and foundations				$ 43,829	
Barrier / collector trench	1,112	lf	$ 571	$ 634,952	
Replace riprap				$ 208,910	
Topsoil	1,477	cy	$ 40	$ 59,061	6" over disturbed area
Reseeding	3.8	acre	$ 2,500	$ 9,576	
Subtotal				$ 1,664,218	
Institutional Controls & Permitting				$ 60,000	
Contractor overhead and profit			0%	$ -	
Design				$ 150,000	
Construction Oversight	6	mo	$ 30,000	$ 180,000	
Removal Completion Report				$ 100,000	
Contingency			20%	$ 333,000	
TOTAL CAPITAL COSTS				**$ 2,487,000**	
Operations, Maintenance, & Monitoring (O&M)					Present value calculation, 3% net interest.
LNAPL collection & disposal	50	yr	$ 7,500	$ 193,000	
Site inspection	50	yr	$ 2,000	$ 51,000	
Maintenance (soil cover & LNAPL trench)	50	yr	$ 3,000	$ 77,000	Allowance
Groundwater monitoring	50	yr	$ 10,000	$ 257,000	
Evaluation and reporting	50	yr	$ 10,000	$ 257,000	
Subtotal			$ 32,500	$ 835,000	
Contingency			25%	$ 209,000	
NET PRESENT VALUE O&M [b]				**$ 1,044,000**	
TOTAL ALTERNATIVE COST				**$ 3,531,000**	Net present value [b]

[a] Costs are for early 2010. Cost include overhead & profit for first-level contractor, but not for general contractor.

[b] The sum of capital and operating costs and the net present value of the post-closure care costs.

Golder Associates

TABLE 10-7
Estimated Cost for Alternative E: Complete Containment/Recovery Replacement and Hot-Spot Treatment

Item	Quantity	Units	Unit Cost	Cost [a]	Notes
CAPITAL COSTS					
Mob/demob, site prep, temp. facilities, site cleanup				$ 139,000	
Cofferdam and other river protection				$ 100,000	
Remove and stockpile clean riprap	2,229	cy	$ 14.00	$ 31,212	
Remove and stockpile clean soil	16,646	cy	$ 9.00	$ 149,816	
Remove & clean riprap and foundations				$ 45,094	
Remove & stockpile contaminated soil				$ 182,665	
Place clean fill	20,613	cy	$ 10.50	$ 216,439	
Barrier / collector trench	1,112	lf	$ 571	$ 634,952	
Replace riprap				$ 208,686	
Clean soil cover	337	cy	$ 10.50	$ 3,542	
Topsoil	1,087	cy	$ 40.00	$ 43,467	6" in disturbed areas
Reseeding	3.3	acre	$ 2,500	$ 8,368	
Soil washing - fixed costs		LS		$ 520,000	Vendor quote
Soil washing - variable costs	15,136	cy	$ 55	$ 832,480	Vendor quote
On-site landfarming of residuals	757	cy	$ 30	$ 22,704	
Subtotal				$ 3,138,426	
Institutional Controls & Permitting				$ 60,000	
Contractor overhead and profit			0%	$ -	
Design				$ 175,000	
Construction Oversight	7	mo	$ 30,000	$ 210,000	
Removal Completion Report				$ 125,000	
Contingency			20%	$ 628,000	
TOTAL CAPITAL COSTS				**$ 4,336,000**	
Operations, Maintenance, & Monitoring (O&M)					Present value calculation, 3% net interest.
LNAPL collection & disposal	30	yr	$ 7,500	$ 147,000	
Site inspection	30	yr	$ 2,000	$ 39,000	
Maintenance (soil cover & LNAPL trench)	30	yr	$ 3,000	$ 59,000	Allowance
Groundwater monitoring	30	yr	$ 10,000	$ 196,000	
Evaluation and reporting	30	yr	$ 10,000	$ 196,000	
Subtotal			$ 32,500	$ 637,000	
Contingency			25%	$ 159,000	
NET PRESENT VALUE O&M [b]				**$ 796,000**	
TOTAL ALTERNATIVE COST				**$ 5,132,000**	Net present value [b]

[a] Costs are for early 2010. Cost include overhead & profit for first-level contractor, but not for general contractor.

[b] The sum of capital and operating costs and the net present value of the post-closure care costs.

TABLE 10-8
Estimated Cost for Alternative F: Complete Containment/Recovery Replacement and Major Source Treatment

Item	Quantity	Units	Unit Cost	Cost [a]	Notes
CAPITAL COSTS					
Mob/demob, site prep, temp. facilities, site cleanup				$ 139,000	
Cofferdam and other river protection				$ 100,000	
Remove and stockpile clean riprap	2,229	cy	$ 14.00	$ 31,212	
Remove and stockpile clean soil	22,822	cy	$ 9.00	$ 205,397	
Remove & clean riprap and foundations				$ 69,919	
Remove & stockpile contaminated soil				$ 348,073	
Excavate & stockpile BCL soil	9,367	cy	$ 9.00	$ 84,301	Soil not requiring treatment
Place clean fill	52,444	cy	$ 10.50	$ 550,661	
Barrier / collector trench	1,112	lf	$ 571	$ 634,952	
Replace riprap				$ 204,303	
Clean soil cover	337	cy	$ 10.50	$ 3,542	
Topsoil	2,116	cy	$ 10.50	$ 22,218	6" in disturbed areas
Reseeding	4.6	acre	$ 2,500	$ 11,558	
Soil washing - fixed costs		LS		$ 520,000	Vendor quote
Soil washing - variable costs	31,424	cy	$ 43	$ 1,351,243	Vendor quote
On-site landfarming of residuals	1,571	cy	$ 30	$ 47,136	
Subtotal				$ 4,323,514	
Institutional Controls & Permitting				$ 60,000	
Contractor overhead and profit			0%	$ -	
Design				$ 200,000	
Construction Oversight	10	mo	$ 30,000	$ 300,000	
Removal Completion Report				$ 150,000	
Contingency			20%	$ 865,000	
TOTAL CAPITAL COSTS				**$ 5,899,000**	
Operations, Maintenance, & Monitoring (O&M)					Present value calculation, 3% net interest.
LNAPL collection & disposal	10	yr	$ 7,500	$ 64,000	
Site inspection	10	yr	$ 2,000	$ 17,000	
Maintenance (soil cover & LNAPL trench)	10	yr	$ 3,000	$ 26,000	Allowance
Groundwater monitoring	10	yr	$ 10,000	$ 85,000	
Evaluation and reporting	10	yr	$ 10,000	$ 85,000	
Subtotal			$ 32,500	$ 277,000	
Contingency			25%	$ 69,000	
NET PRESENT VALUE O&M [b]				**$ 346,000**	
TOTAL ALTERNATIVE COST				**$ 6,245,000**	Net present value [b]

[a] Costs are for early 2010. Cost include overhead & profit for first-level contractor, but not for general contractor.

[b] The sum of capital and operating costs and the net present value of the post-closure care costs.

Golder Associates

TABLE 10-9
Estimated Cost for Alternative G: Treatment of Entire LNAPL Plume

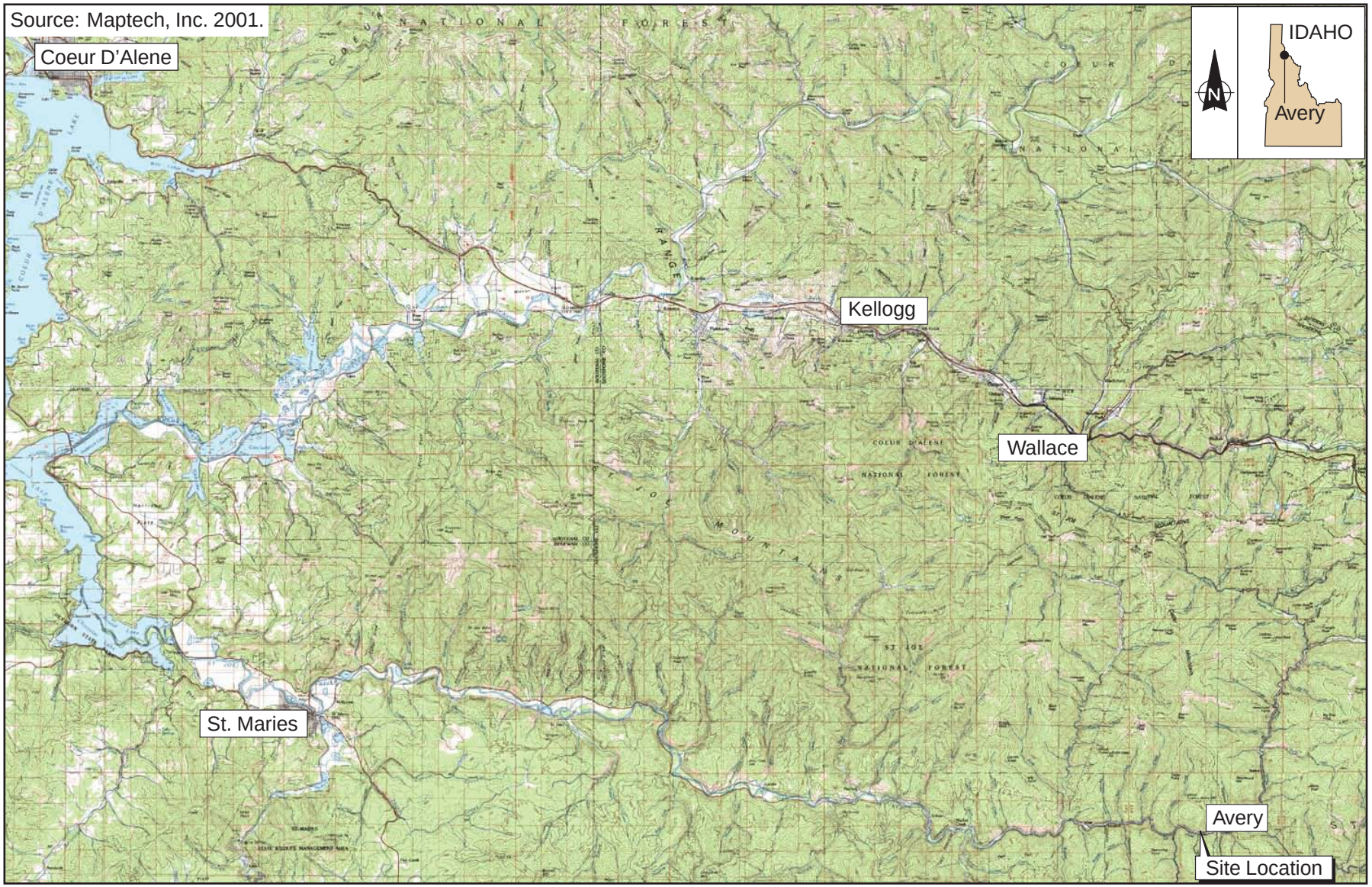
Item	Quantity	Units	Unit Cost	Cost [a]	Notes
CAPITAL COSTS					
Mob/demob, site prep, temp. facilities, site cleanup				$ 139,000	
Cofferdam and other river protection				$ 100,000	
Remove and stockpile clean riprap	2,229	cy	$ 14.00	$ 31,212	
Remove and stockpile clean soil	32,504	cy	$ 9.00	$ 292,539	
Remove & clean riprap and foundations				$ 91,269	
Remove & stockpile contaminated soil				$ 757,992	
Excavate & stockpile BCL soil	24,131	cy	$ 9.00	$ 217,180	Soil not requiring treatment
Place clean fill	119,347	cy	$ 10.50	$ 1,253,142	
Replace riprap				$ 311,918	
Topsoil	3,016	cy	$ 40.00	$ 120,656	6" in disturbed areas
Reseeding	9.6	acre	$ 2,500	$ 23,933	
Temporary road	1,084	lf	$ 87	$ 93,846	
Reconstruct permanent road	576	lf	$ 124	$ 71,467	
Soil washing - fixed costs		LS		$ 520,000	Vendor quote
Soil washing - variable costs	68,335	cy	$ 30	$ 2,050,056	Vendor quote
On-site landfarming of residuals	3,417	cy	$ 30	$ 102,503	
Subtotal				$ 6,176,711	
Institutional Controls & Permitting				$ 60,000	
Contractor overhead and profit			0%	$ -	
Design				$ 200,000	
Construction Oversight	12	mo	$ 30,000	$ 360,000	
Removal Completion Report				$ 150,000	
Contingency			20%	$ 1,235,000	
TOTAL CAPITAL COSTS				**$ 8,182,000**	
Operations, Maintenance, & Monitoring (O&M)					Present value calculation, 3% net interest.
LNAPL collection & disposal	0	yr	$ 7,500	$ -	
Site inspection	0	yr	$ 2,000	$ -	
Maintenance	0	yr	$ -	$ -	
Groundwater monitoring	0	yr	$ 10,000	$ -	
Evaluation and reporting	0	yr	$ 10,000	$ -	
Subtotal			$ 29,500	$ -	
Contingency			25%	$ -	
NET PRESENT VALUE O&M [b]				**$ -**	
TOTAL ALTERNATIVE COST				**$ 8,182,000**	Net present value [b]

[a] Costs are for early 2010. Cost include overhead & profit for first-level contractor, but not for general contractor.

[b] The sum of capital and operating costs and the net present value of the post-closure care costs.

Golder Associates

FIGURES



Source: Ecology and Environment, Inc., 2007

FIGURE **1-1**
SITE LOCATION MAP
EE/CA WORK PLAN AVERY LANDING SITE/WA

LEGEND

- Property Line & Section 16-15 Division Line
- Site Boundary

0 140

APPROXIMATE
SCALE IN FEET

FIGURE **1-2**

SITE LAYOUT MAP

EE/CA WORK PLAN AVERY LANDING SITE/WA

LEGEND:

- HISTORICAL RAILROAD TRACKS
- HISTORICAL FEATURES
- HISTORICAL PIPING

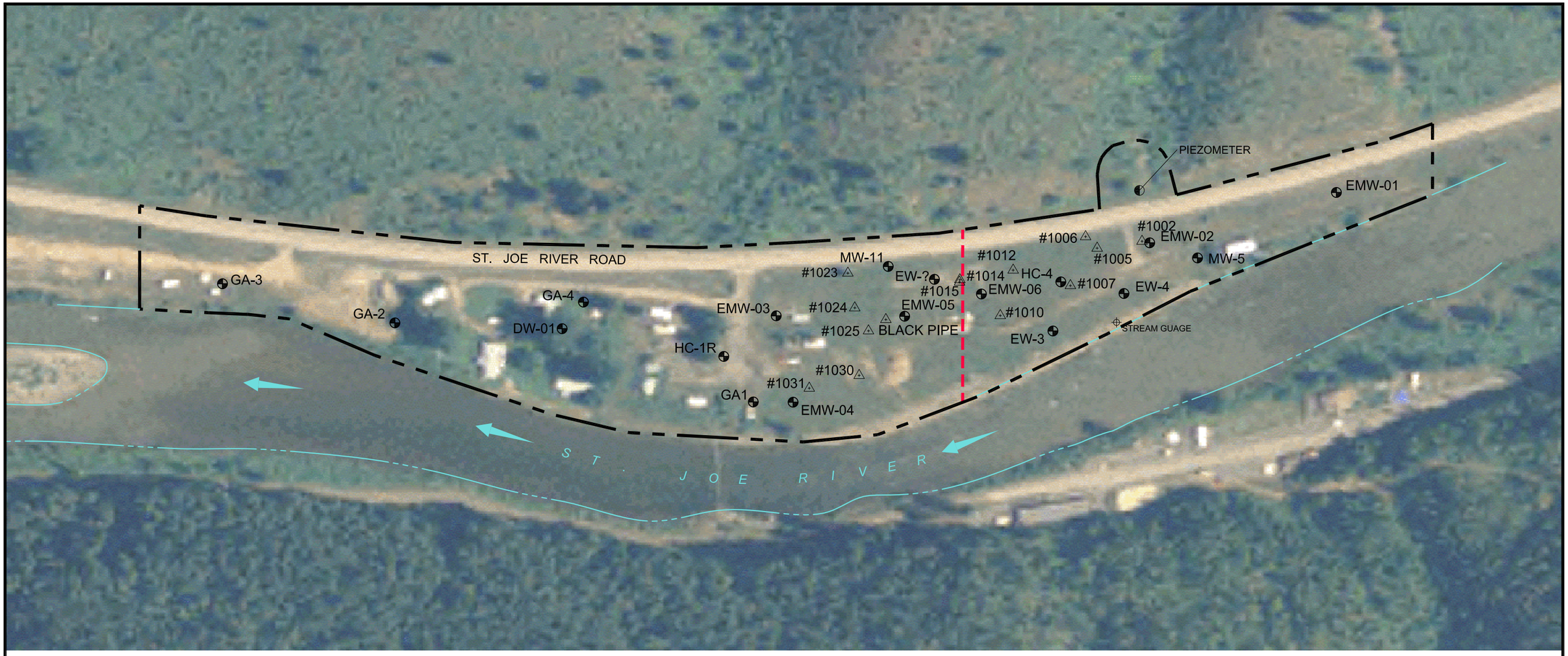
0 160 320

SCALE IN FEET

FIGURE **2-1**

HISTORICAL RAILROAD FACILITY LAYOUT

POTLATCH/AVERY LANDING EE/CA IMP/WA (US) \ EE/CA REPORT



LEGEND:

- SITE BOUNDARY
- EDGE OF WATER
- PROPERTY LINE AND SECTION 16-15 DIVISION LINE
- MONITORING WELL
- STICK-UP PIPE

0 160 320

SCALE IN FEET

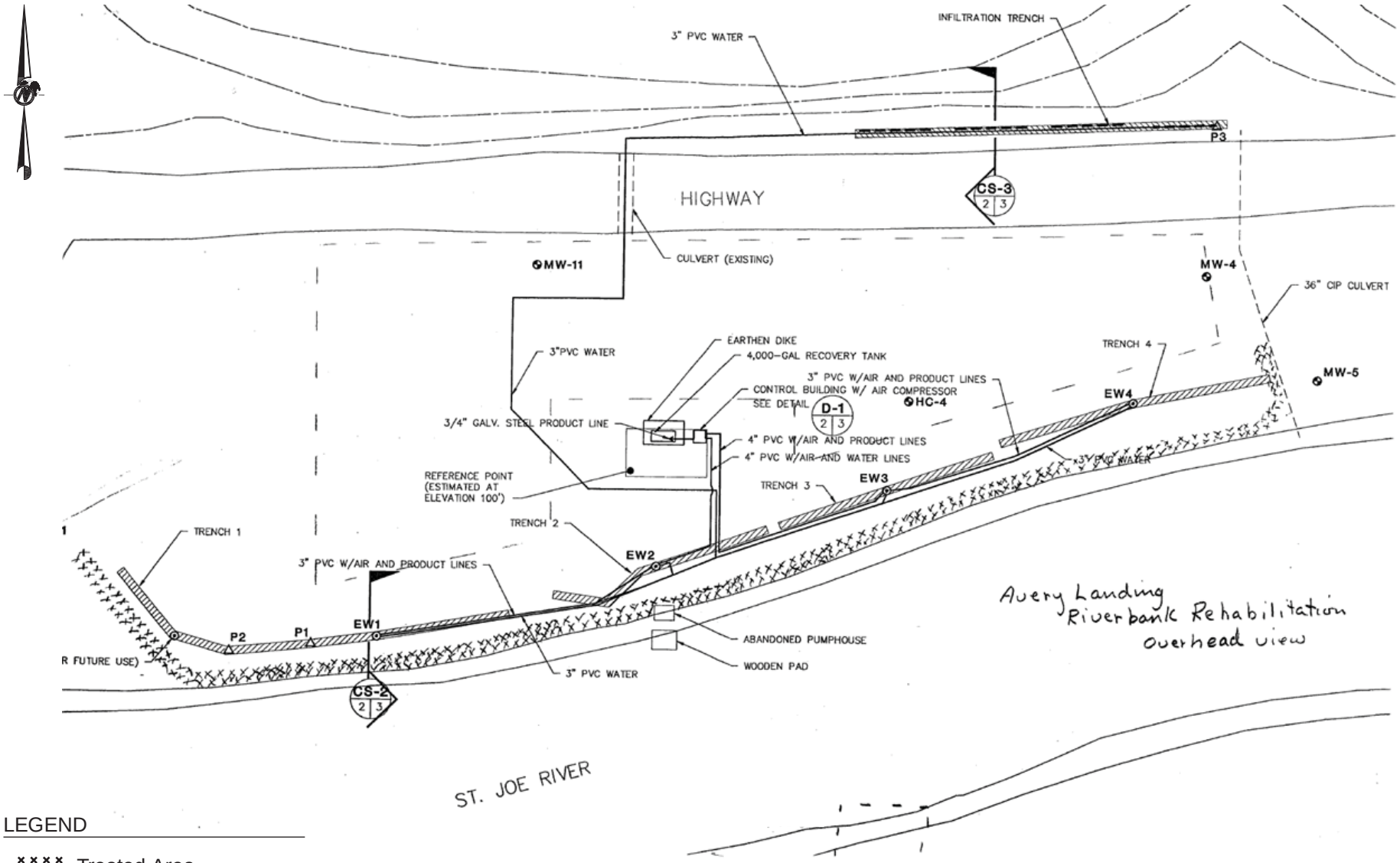
FIGURE **2-2**

HISTORICAL MONITORING WELL AND STICK-UP PIPE LOCATION MAP

POTLATCH/AVERY LANDING EE/CA IMP/WA (US) \ EE/CA REPORT

K:\CAD\Projects\2007\07393312\x03\6\Working\073_93312_03_6-F2-1 to F4-3.dwg | Fig 2-2 | Mod: 12/09/2009, 10:23 | Plotted: 12/09/2009, 10:26 | SSimmons

Golder Associates



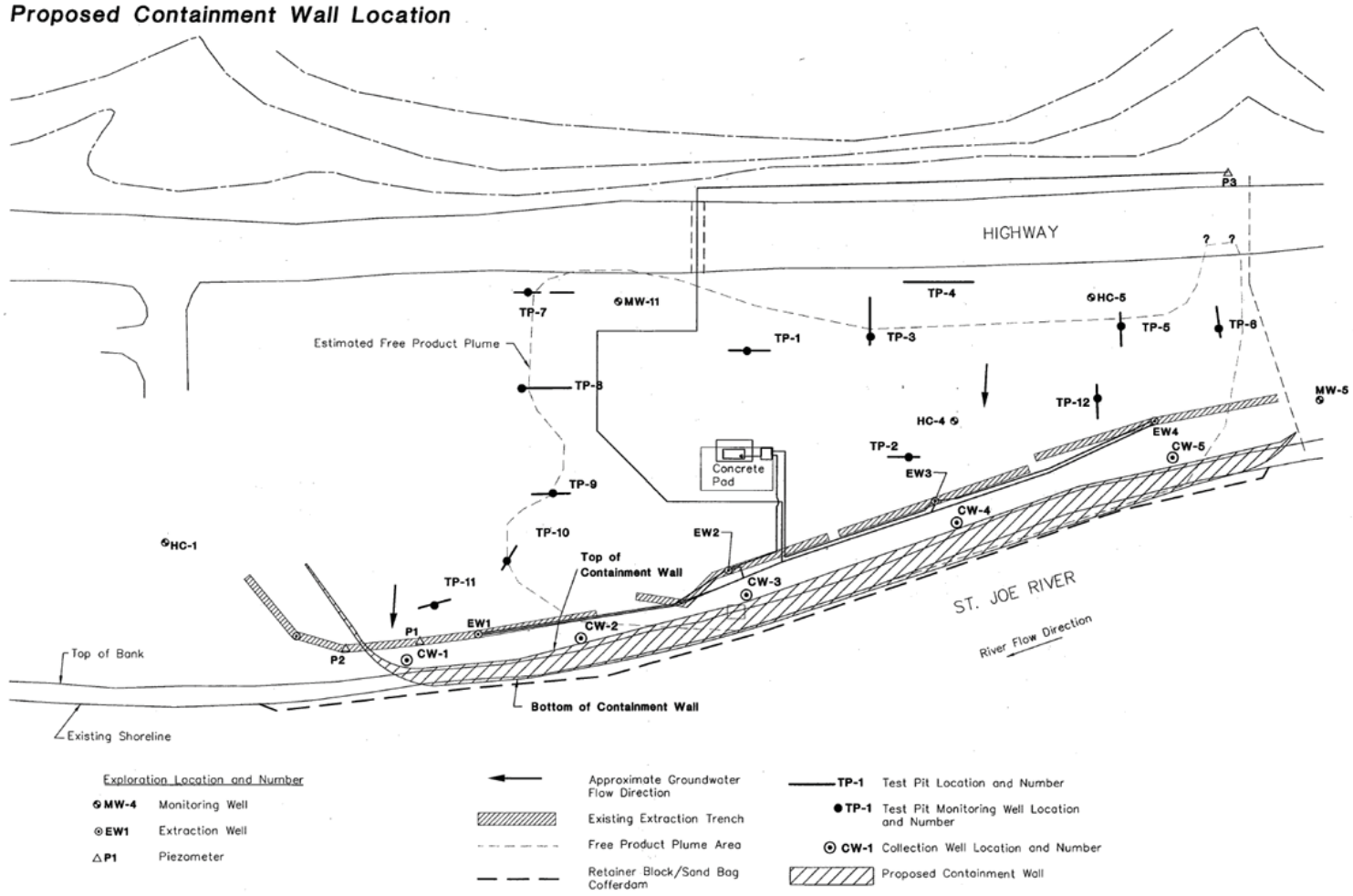
Source: HartCrowser, February 10, 2000

FIGURE **2-3**

EXTRACTION & INFILTRATION TRENCHES

POTLATCH/AVERY LANDING PROJECT

Golder Associates



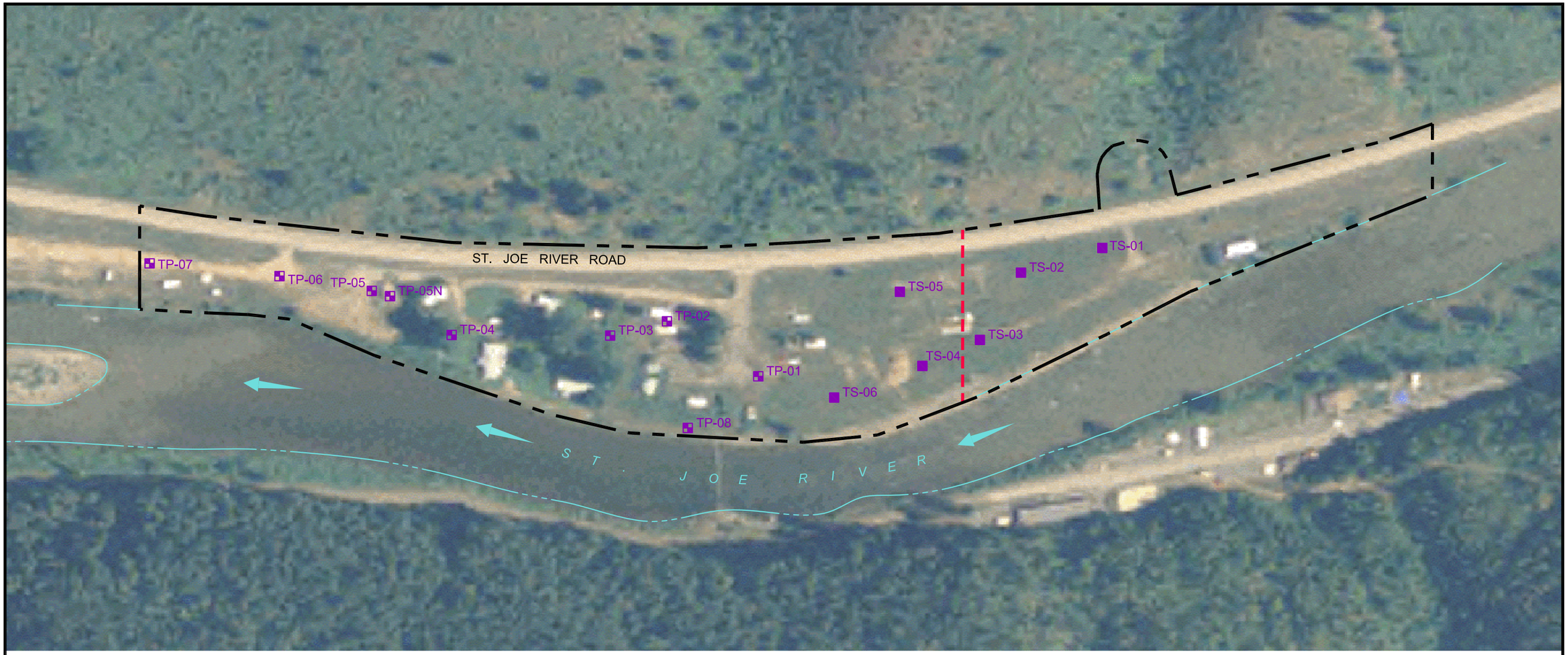
Source: HartCrowser, August 15, 2000

FIGURE **2-4**

IMPERMEABLE VERTICAL WALL

POTLATCH/AVERY LANDING PROJECT

Golder Associates



LEGEND:

- SITE BOUNDARY
- EDGE OF WATER
- PROPERTY LINE AND SECTION 16-15 DIVISION LINE
- TEST PIT LOCATION
- TREATABILITY STUDY TEST PIT LOCATION

0 160 320

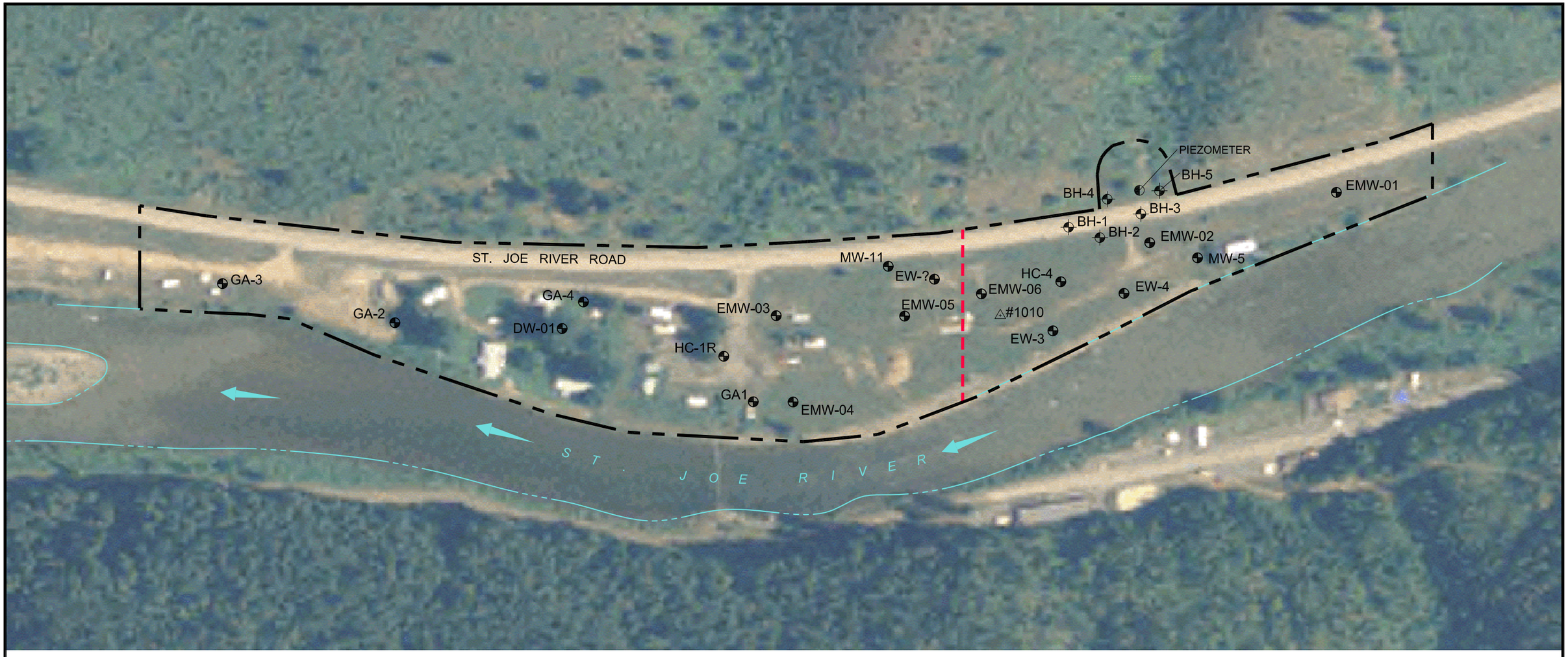
SCALE IN FEET

FIGURE **3-1**

TEST PIT LOCATION MAP

POTLATCH/AVERY LANDING EE/CA IMP/WA (US) \ EE/CA REPORT

Golder Associates



LEGEND:

- SITE BOUNDARY
- EDGE OF WATER
- PROPERTY LINE AND SECTION 16-15 DIVISION LINE
- MONITORING WELL
- SOIL BORING LOCATION
- PIEZOMETER

0 160 320

SCALE IN FEET

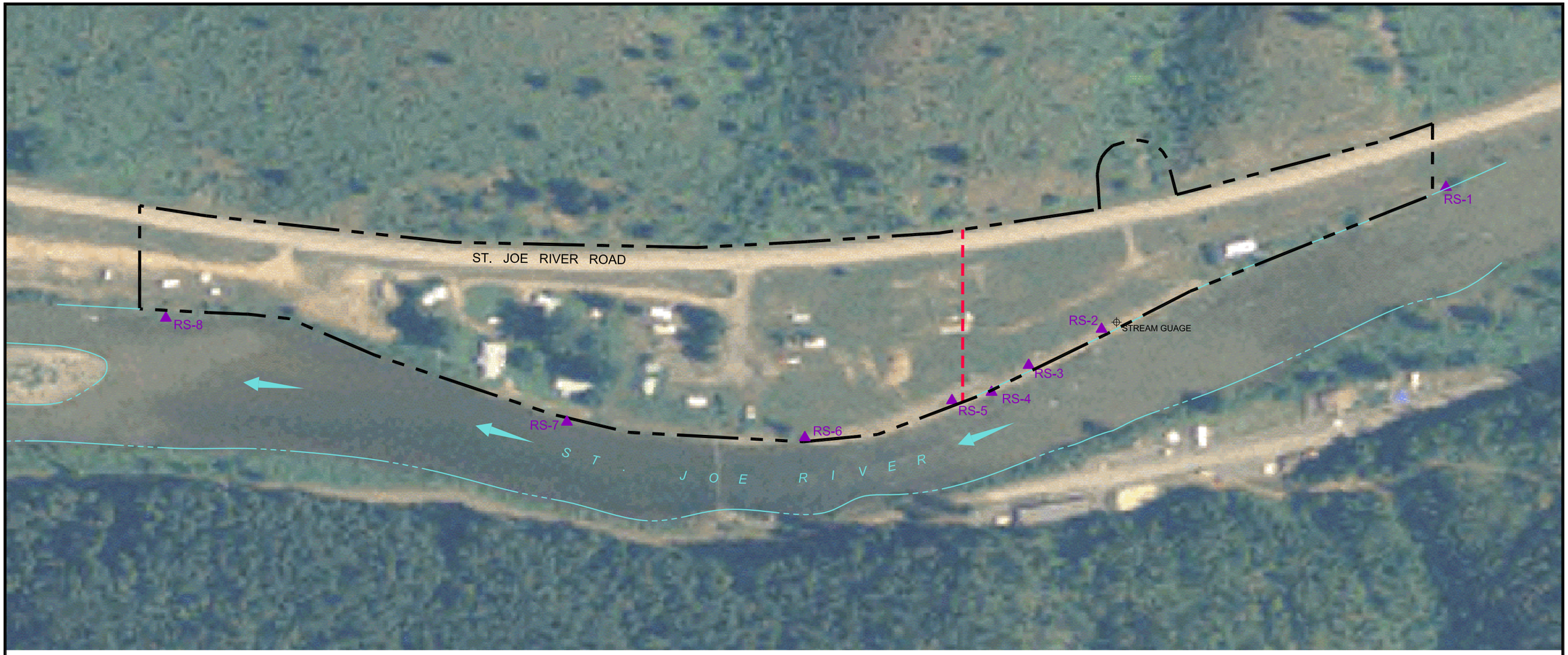
FIGURE **3-2**

MONITORING WELL AND BORING LOCATIONS MAP

POTLATCH/AVERY LANDING EE/CA IMP/WA (US) \ EE/CA REPORT

K:\CAD\Projects\2007\07393312\x03\6\Working\073_93312_03_6-F2-1 to F4-3.dwg | Fig 3-2 | Mod: 12/21/2009, 09:24 | Plotted: 12/21/2009, 13:53 | SSimmons

Golder Associates



LEGEND:

- SITE BOUNDARY
- EDGE OF WATER
- PROPERTY LINE AND SECTION 16-15 DIVISION LINE
- ▲ SURFACE WATER AND SEDIMENT SAMPLE LOCATION

0 160 320

SCALE IN FEET

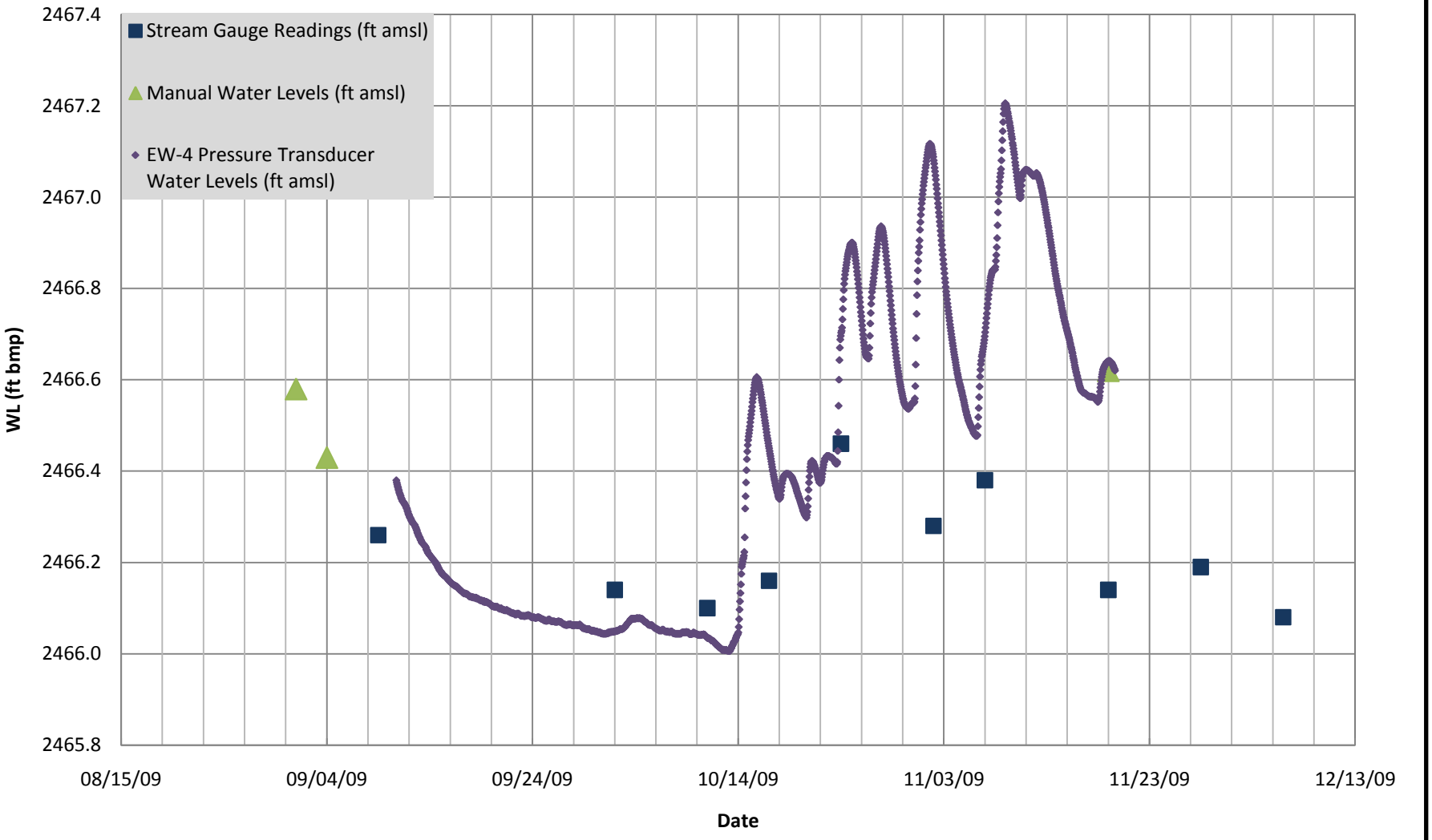
FIGURE **3-3**

RIVER STATION LOCATION MAP

POTLATCH/AVERY LANDING EE/CA IMP/WA (US) \ EE/CA REPORT

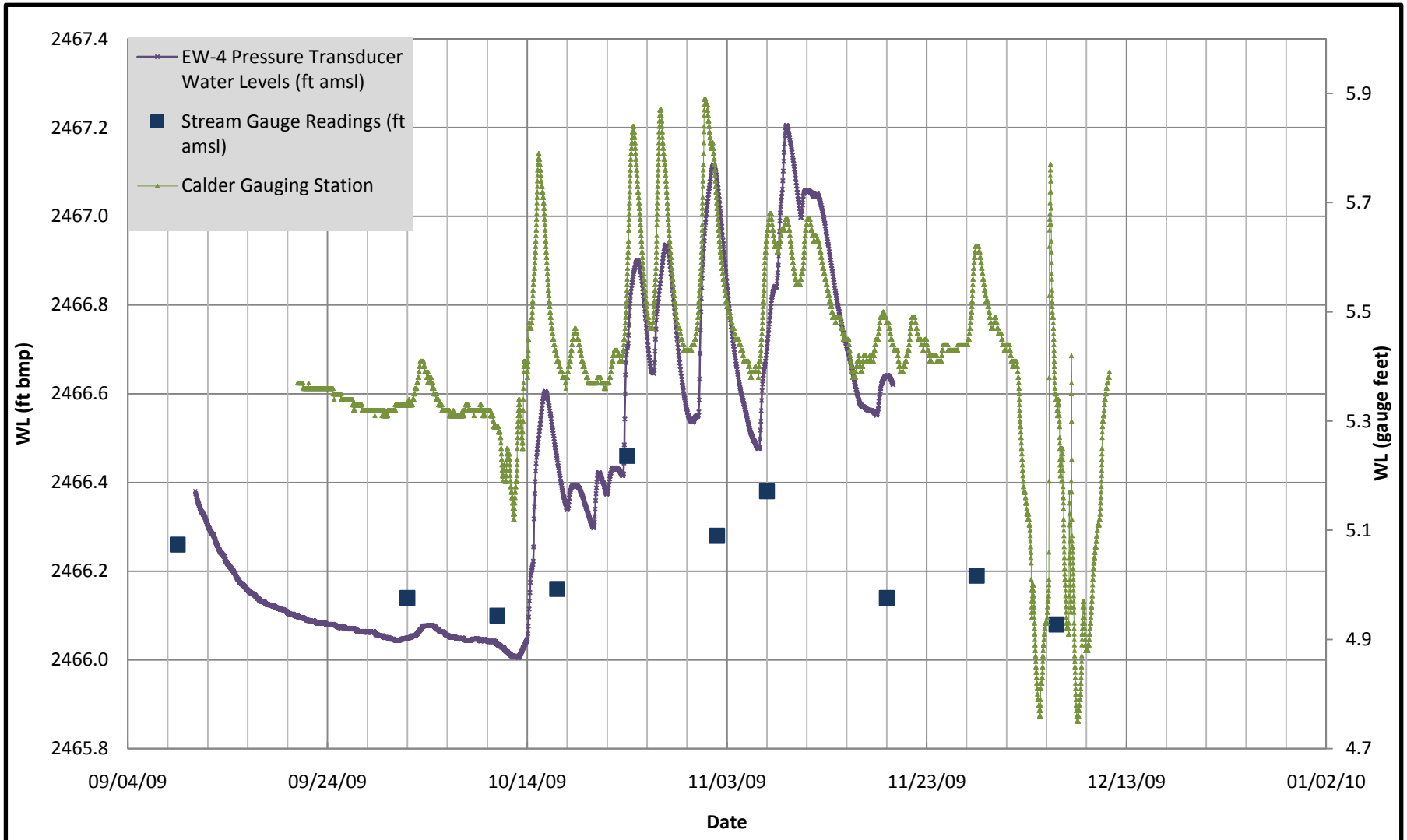
K:\CAD\Projects\2007\07393312\x03\6\Working\073_93312_03_6-F3-1 to F3-4.dwg | Fig 3-3 | Mod: 11/24/2009, 13:25 | Plotted: 11/25/2009, 11:22 | SSimmons

Golder Associates



Golder Associates	Title: EW-04 Hydrograph & Stream Gauge Data		Drawn: LB
			Checked: KL
			Reviewed: DM
	Project Name: Potlatch/Avery Landing	Project No.: 739331203	FIGURE 3-4
	Client Name: Potlatch	Date: December 11, 2009	

V:\PROJECTS_2007 PROJECTS\073-93312 Avery Landing\EE-CA Report\Figures\Figures 3-4; 3-5; and 3-6.xlsx



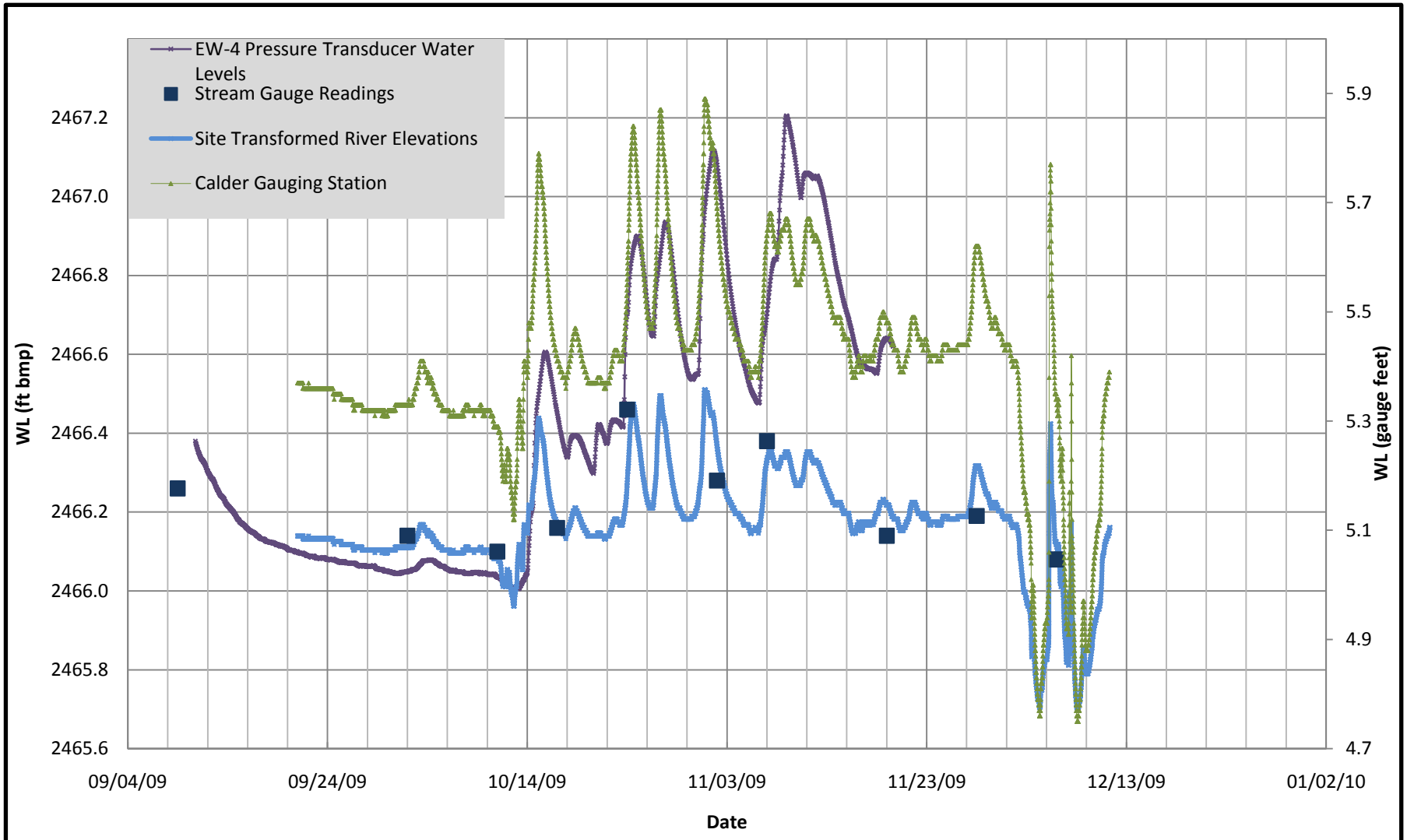
Golder Associates

Title	EW-04 Transducer & Calder Gauging Station Hydrograph		
Project Name	Potlatch/Avery Landing	Project No.	739331203
Client Name	Potlatch	Date	December 11, 2009

Drawn	LB
Checked	KL
Reviewed	DM

FIGURE 3-5

V:\PROJECTS_2007 PROJECTS\073-93312 Avery Landing\EE-CA Report\Figures\Figures 3-4; 3-5; and 3-6.xlsx



Golder Associates

Title	Transformed Hydrograph Data		
Project Name	Potlatch/Avery Landing	Project No.	739331203
Client Name	Potlatch	Date	December 22, 2009

Drawn	LB
Checked	KL
Reviewed	DM

FIGURE 3-6

V:\PROJECTS_2007 PROJECTS\073-93312 Avery Landing\EE-CA Report\Figures\Figures 3-4; 3-5; and 3-6.xlsx

LEGEND:

- 2464.0 — GROUNDWATER CONTOUR AND ELEVATION (9/1/09) ABOVE MEAN SEA LEVEL
- GROUNDWATER FLOW ARROW
- MONITORING WELL
- SOIL BORING LOCATION
- PIEZOMETER

* GROUNDWATER ELEVATION CALCULATED USING LNAPL PRODUCT THICKNESS (POTENTIAL METRIC)

0 150 300

SCALE IN FEET

FIGURE **4-1**

GROUNDWATER CONTOURS (9/1/09)

POTLATCH/AVERY LANDING EE/CA IMP/WA (US) \ EE/CA REPORT

K:\CAD\Projects\2007\07393312\x03\6\Working\073_93312_03_6-F2-1 to F4-3.dwg | Fig 4-1 | Mod: 12/21/2009, 09:24 | Plotted: 12/21/2009, 13:53 | SSimmons

Golder Associates

LEGEND:

- 2464.0 — GROUNDWATER CONTOUR AND ELEVATION (11/19/09) ABOVE MEAN SEA LEVEL
- GROUNDWATER FLOW ARROW
- MONITORING WELL
- SOIL BORING LOCATION
- PIEZOMETER

* GROUNDWATER ELEVATION CALCULATED USING LNAPL PRODUCT THICKNESS (POTENTIAL METRIC)

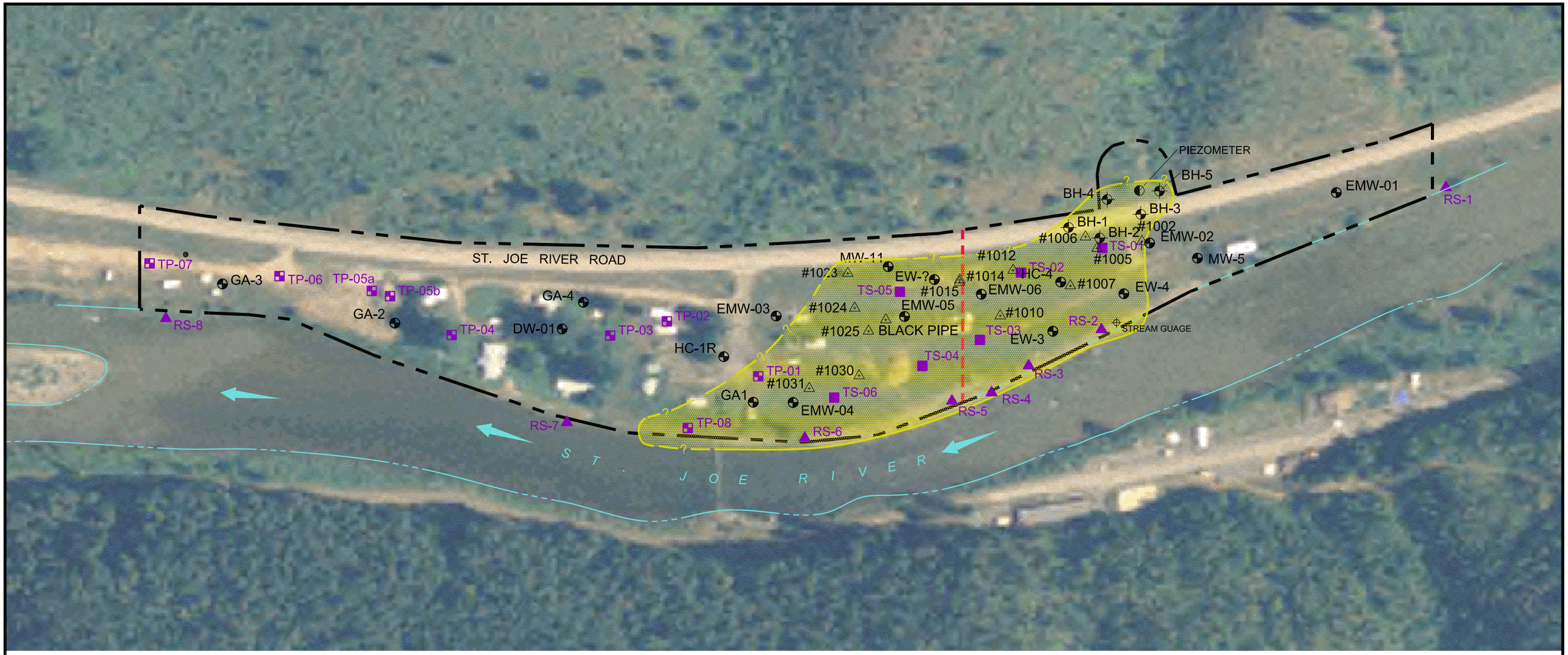
0 150 300

SCALE IN FEET

FIGURE **4-2**

GROUNDWATER CONTOURS (11/19/09)

POTLATCH/AVERY LANDING EE/CA IMP/WA (US) \ EE/CA REPORT



LEGEND:

- SITE BOUNDARY
- EDGE OF WATER
- PROPERTY LINE AND SECTION 16-15 DIVISION LINE
- ESTIMATED FREE PRODUCT PLUME BOUNDARY
- MONITORING WELL
- STICK-UP PIPE
- SURFACE WATER SAMPLE LOCATION
- SOIL BORING LOCATION
- TEST PIT LOCATION
- PIEZOMETER
- TREATABILITY STUDY TEST PIT LOCATION

0 160 320

SCALE IN FEET

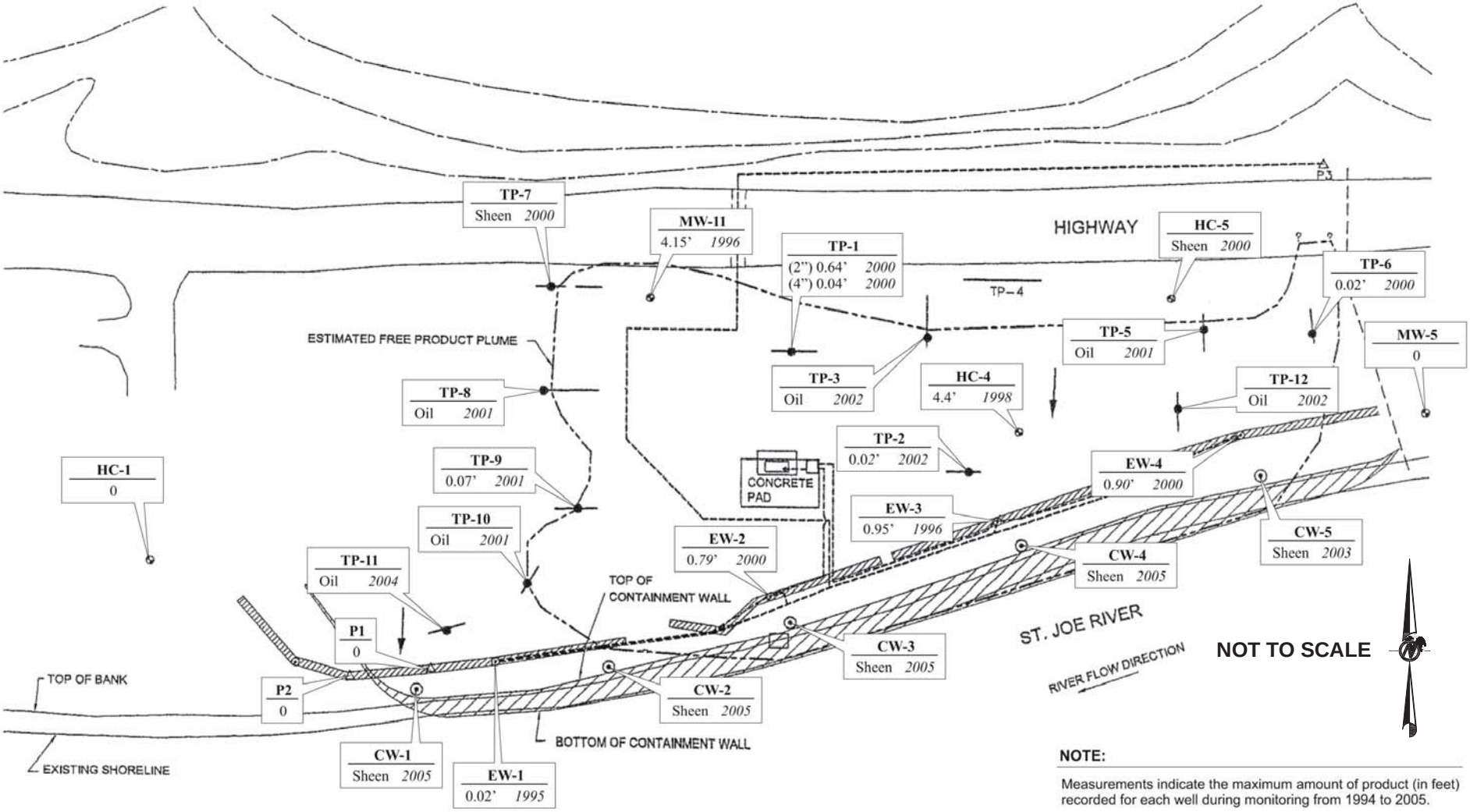
FIGURE **4-3**

FREE PRODUCT PLUME

POTLATCH/AVERY LANDING EE/CA IMP/WA (US) \ EE/CA REPORT

K:\CAD\Projects\2007\07393312\x03\6\Working\073_93312_03_6-F2-1 to F4-3.dwg | Fig 4-3 | Mod: 12/21/2009, 14:01 | Plotted: 01/21/2010, 09:09 | SSimmons

Golder Associates



NOTE:

Measurements indicate the maximum amount of product (in feet) recorded for each well during monitoring from 1994 to 2005.

The date indicates the latest year the maximum observation was recorded.

"0" indicates that no product or sheen was recorded in the available data from 1994 to 2005.

"Sheen" indicates that a sheen was observed, but no measurable product was observed.

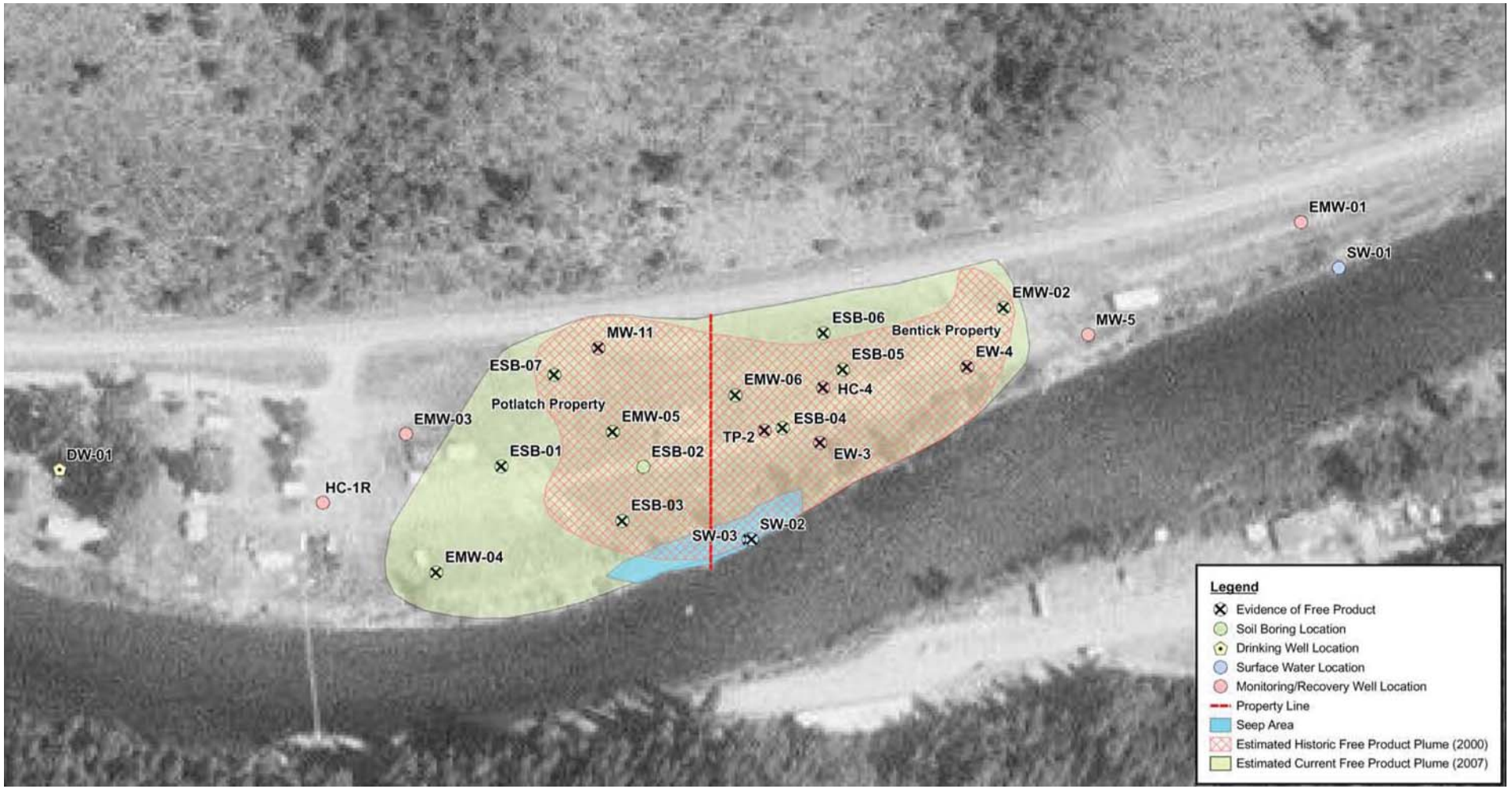
"Oil" indicates that free product was present, but the thickness could not be determined.

FIGURE **4-4**

HART CROWSER & FARALLON CONSULTING'S FREE PRODUCT PLUME

POTLATCH/AVERY LANDING PROJECT

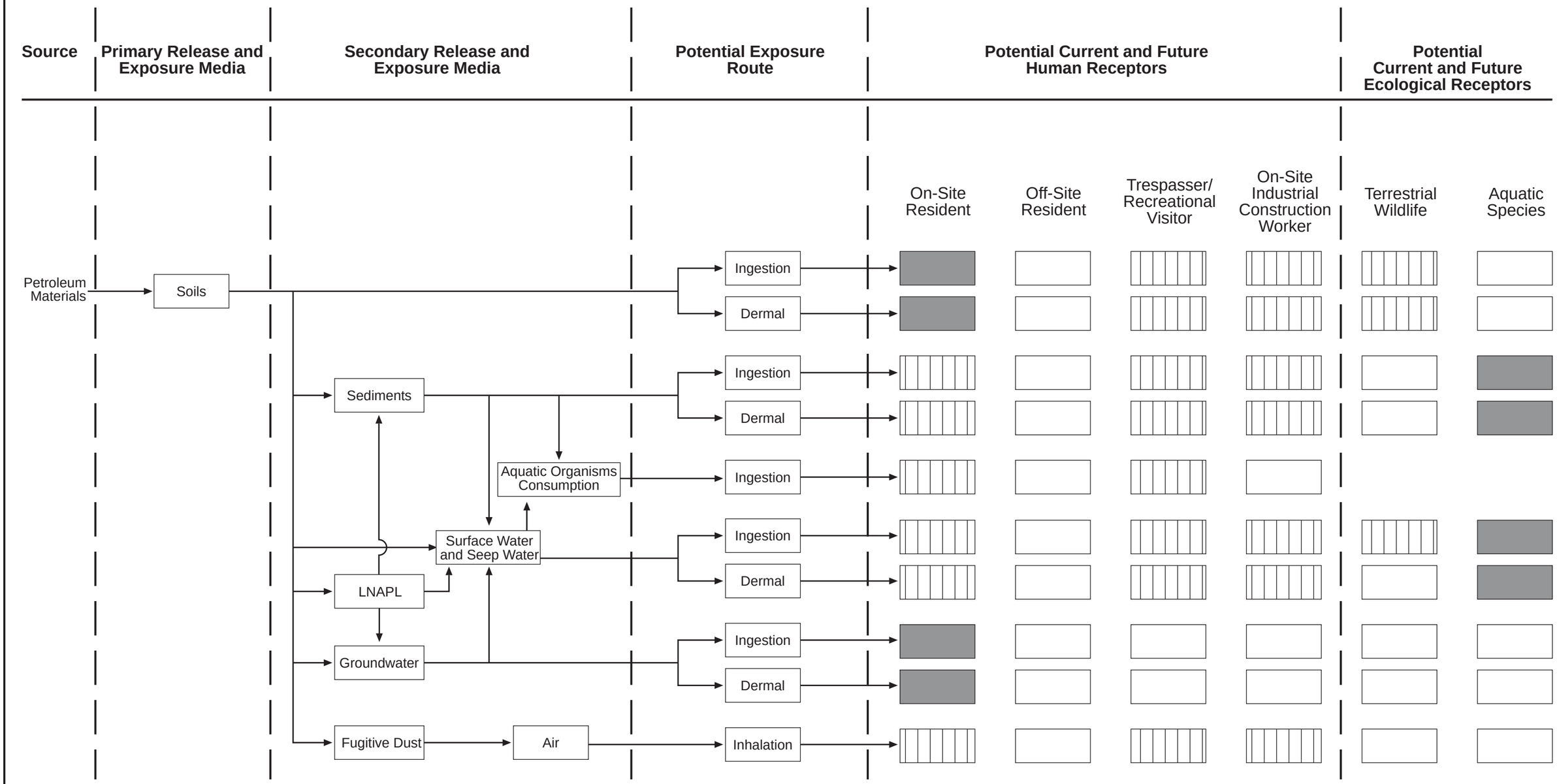
Source: Hart Croswer (2000) and Farallon Consulting (2006)



NOT TO SCALE

FIGURE **4-5**
ECOLOGY & ENVIRONMENT'S FREE PRODUCT PLUME
POTLATCH/AVERY LANDING PROJECT

Source: Ecology & Environment (2007)



LEGEND

- Pathway is Incomplete
- Pathway is Complete or Potentially Complete; Exposure is Considered Insignificant
- Pathway Complete or Potentially Complete

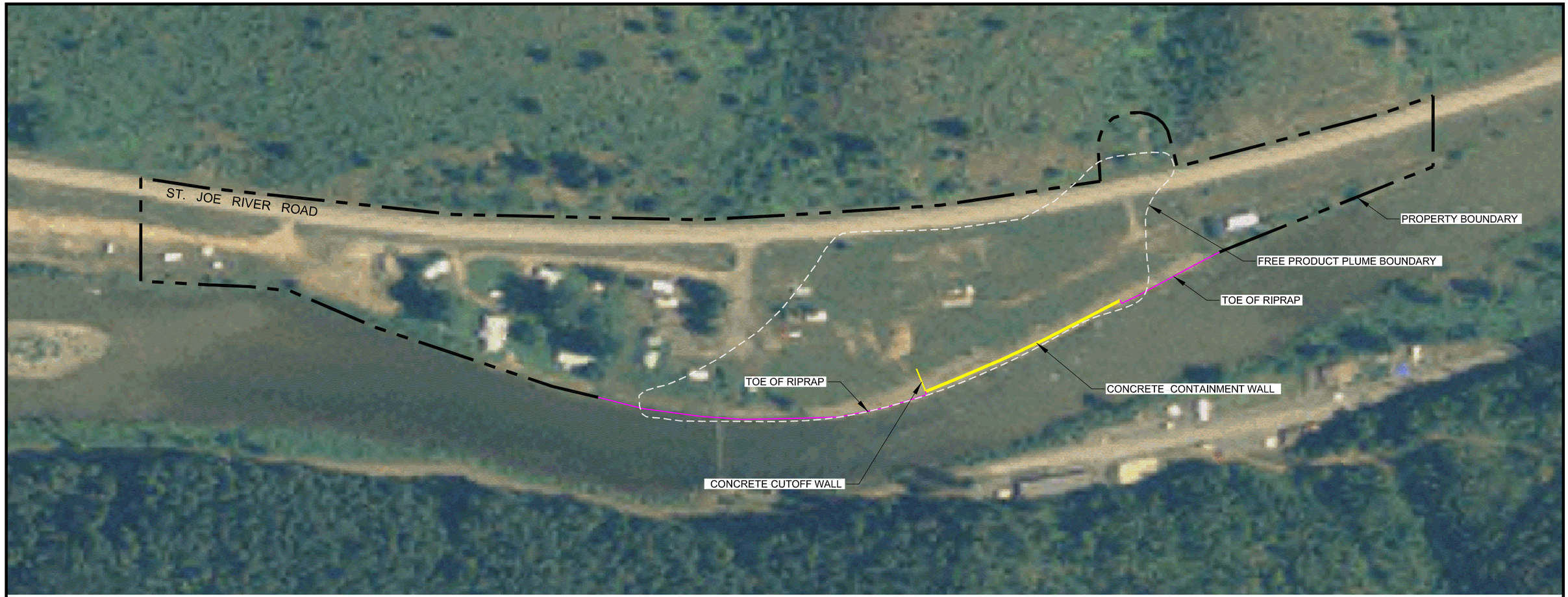
FIGURE **5-1**

CONCEPTUAL SITE MODEL FOR HUMAN AND ECOLOGICAL RISK EVALUATION

AVERY LANDING SITE, AVERY, IDAHO

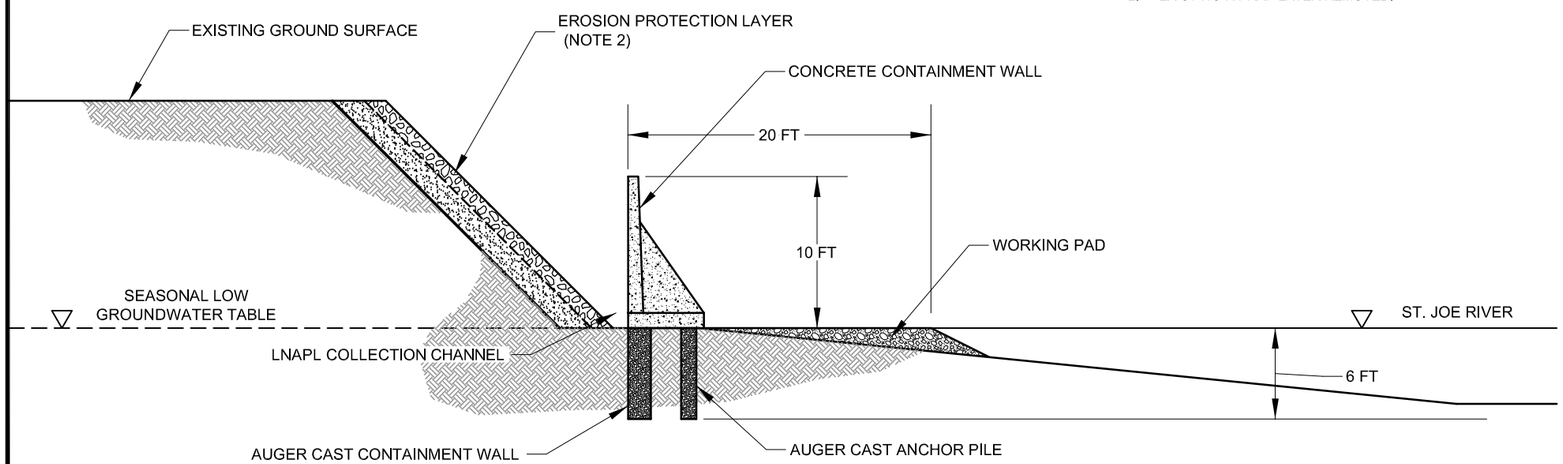
073933120309fig5-1.ai | Mod: 12/21/09 | AMP

Golder Associates



NOTES

1. DIMENSIONS ARE ASSUMED FOR ESTIMATING PURPOSES.
2. EXISTING RIPRAP LAYER REMOVED.



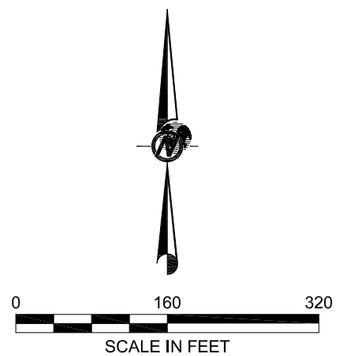


FIGURE **9-1**

CONCRETE CONTAINMENT WALL PLAN VIEW AND SECTION

POTLATCH / AVERY LANDING EECA / ID

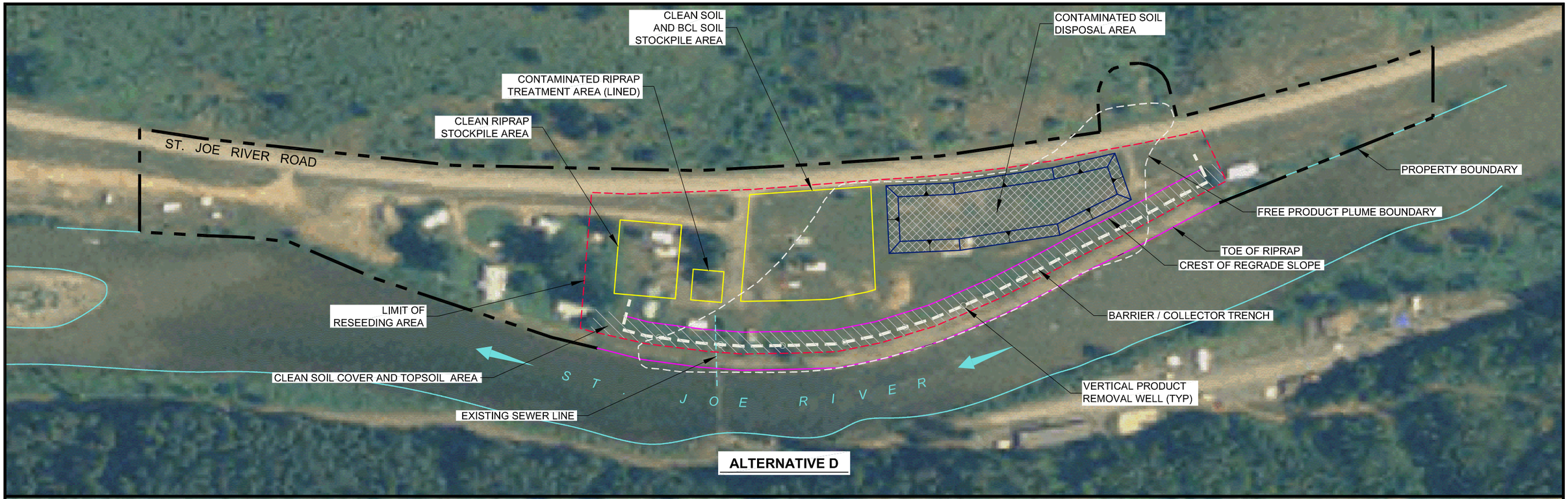


FIGURE **9-2**

BARRIER / COLLECTOR TRENCH LAYOUT

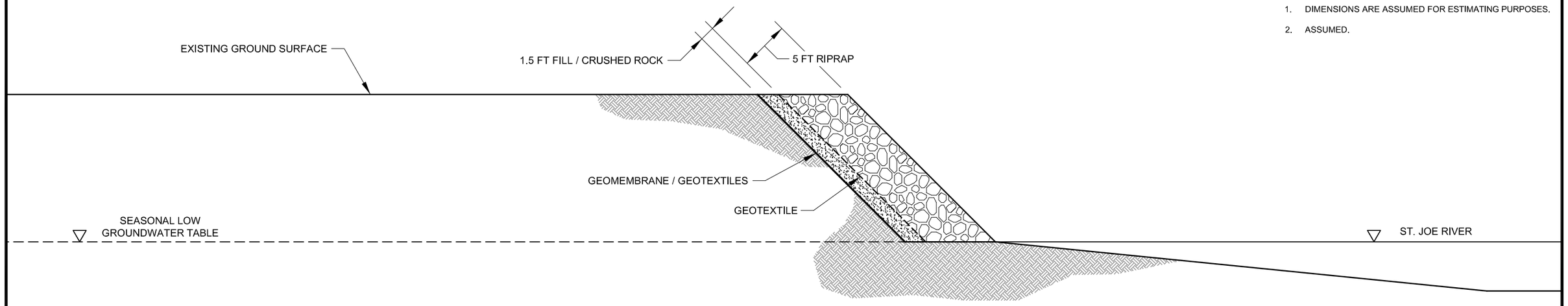
POTLATCH / AVERY LANDFIN EECA / ID

K:\CAD\Projects\2007\07393312\x03\09\B-C Wall 2009-01-06\073_93312_09 F20 d1.dwg | Plan Facil | Mod: 01/13/2010, 09:17 | Plotted: 01/13/2010, 09:18 | fshuri

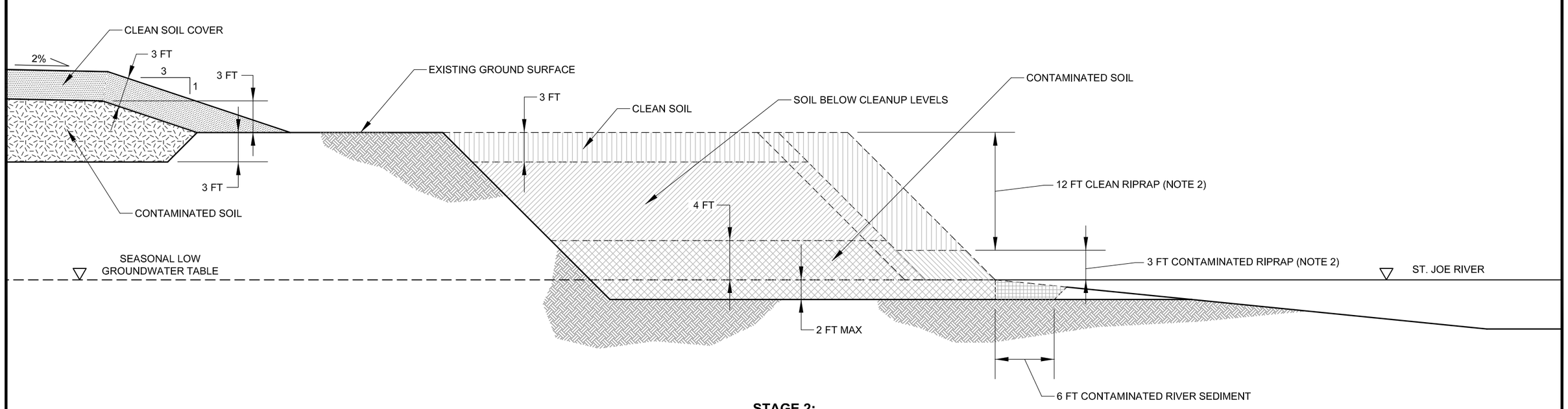
Golder Associates

NOTES

1. DIMENSIONS ARE ASSUMED FOR ESTIMATING PURPOSES.
2. ASSUMED.



STAGE 1:
EXISTING CONDITIONS



STAGE 2:
SHORELINE REMOVAL AND COVERING

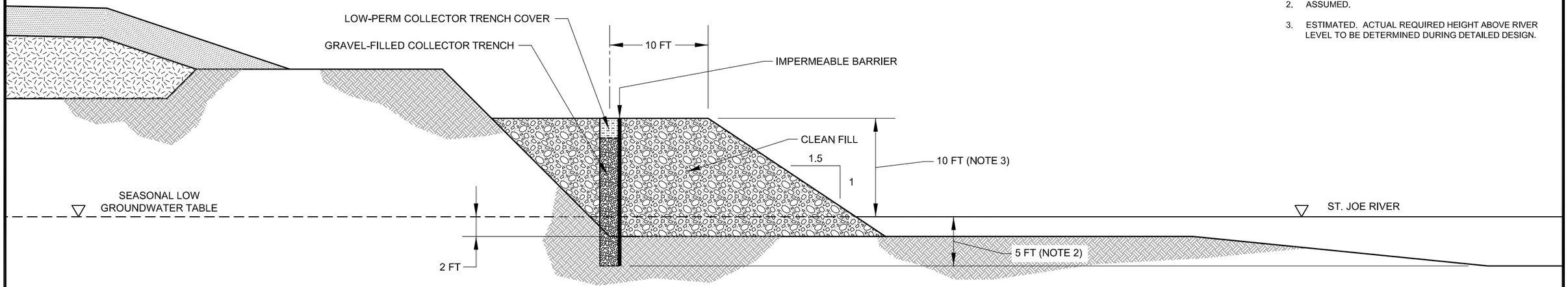
FIGURE **9-3**

BARRIER / COLLECTOR TRENCH - STAGES 1 AND 2

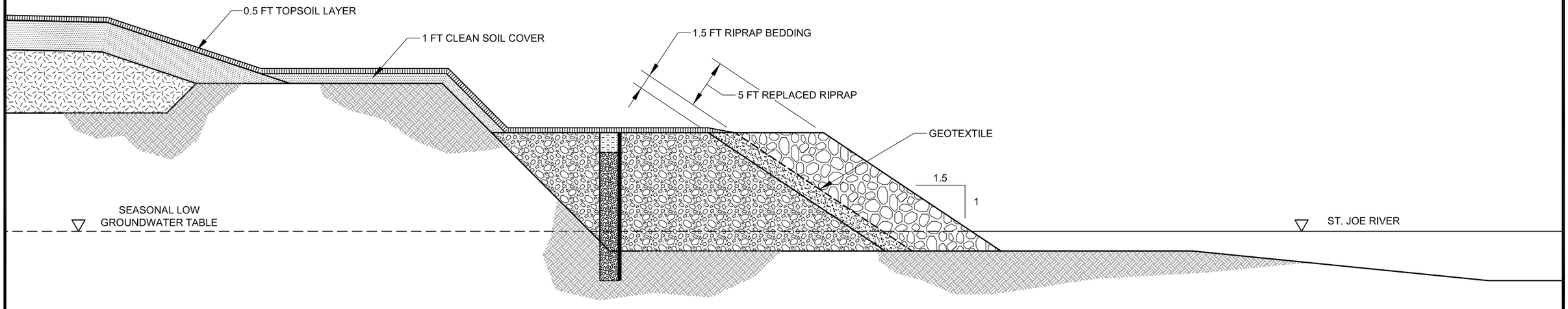
POTLATCH / AVERY LANDING EECA / ID

NOTES

1. DIMENSIONS ARE ASSUMED FOR ESTIMATING PURPOSES.
2. ASSUMED.
3. ESTIMATED. ACTUAL REQUIRED HEIGHT ABOVE RIVER LEVEL TO BE DETERMINED DURING DETAILED DESIGN.



STAGE 3:
FILL AND BARRIER / COLLECTOR TRENCH



STAGE 4:
FINAL CONDITIONS

FIGURE **9-4**

BARRIER / COLLECTOR TRENCH - STAGES 3 AND 4

POTLATCH / AVERY LANDING EECA / ID

Golder Associates

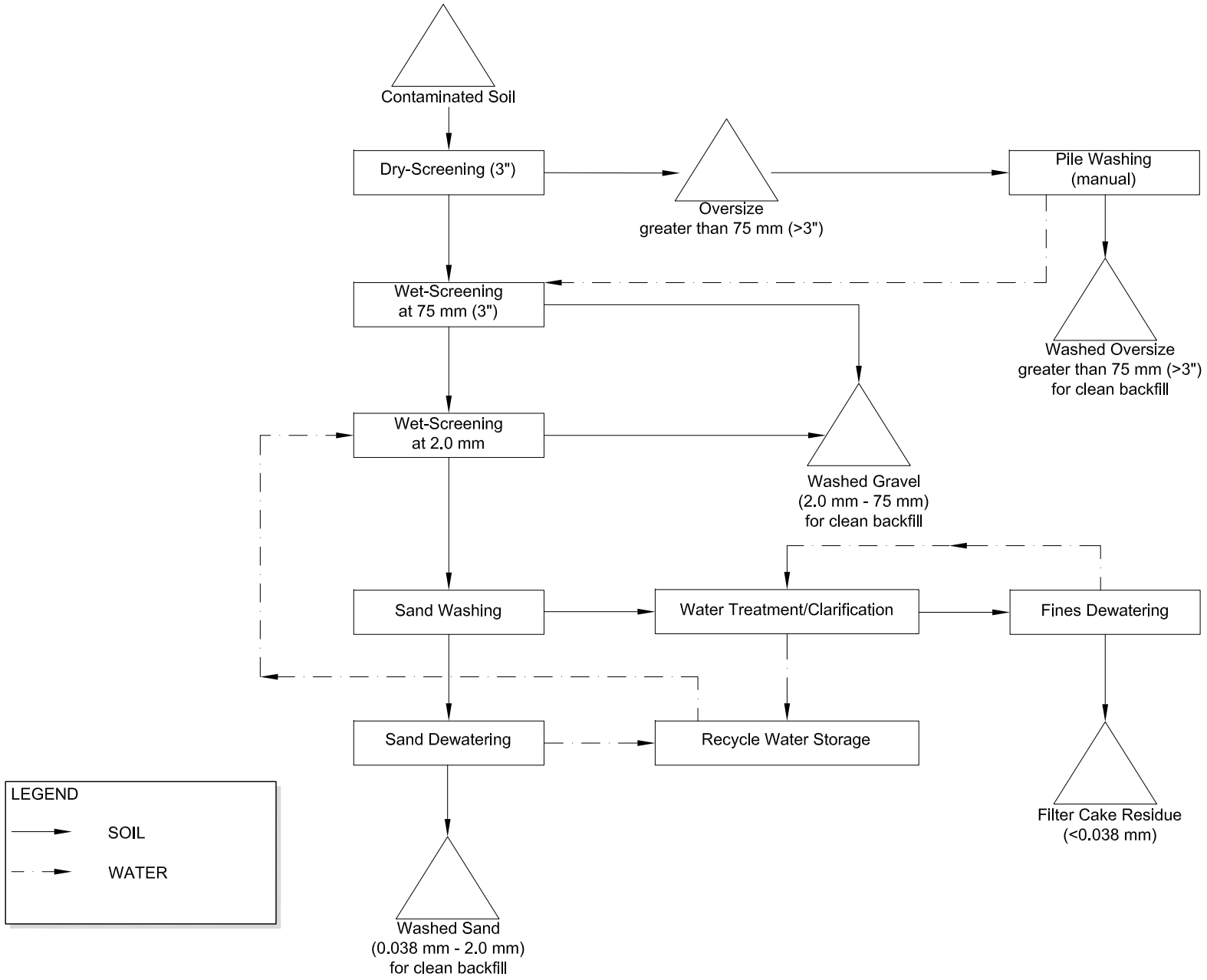


FIGURE **9-5**

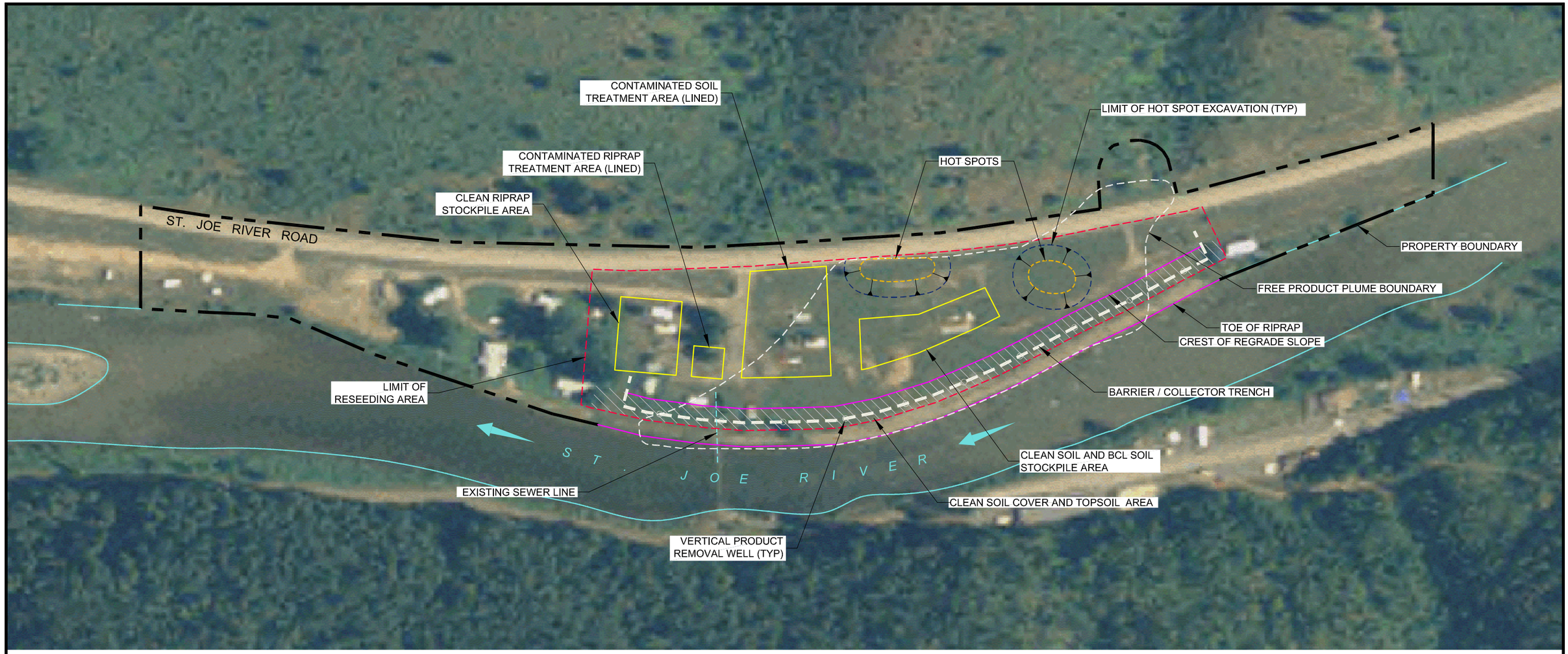
SOIL WASHING PROCESS FLOW DIAGRAM

POTLATCH/AVERY LANDING EE/CA IMP/WA

SOURCE: ART ENGINEERING

K:\CAD\Projects\2007\07393312\x03\09\073_93312_03_09_F9-5.dwg | Layout1 | Mod: 01/06/2010, 08:49 | Plotted: 01/11/2010, 12:23 | aforcier

Golder Associates



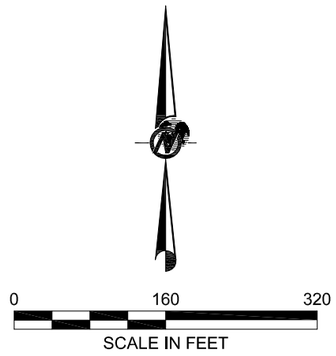


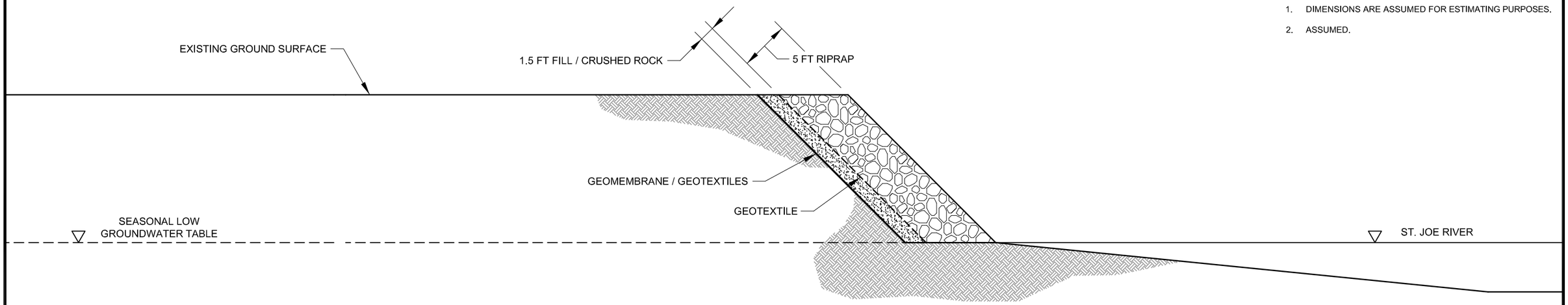
FIGURE **9-6**

HOT SPOT REMOVAL PLAN VIEW

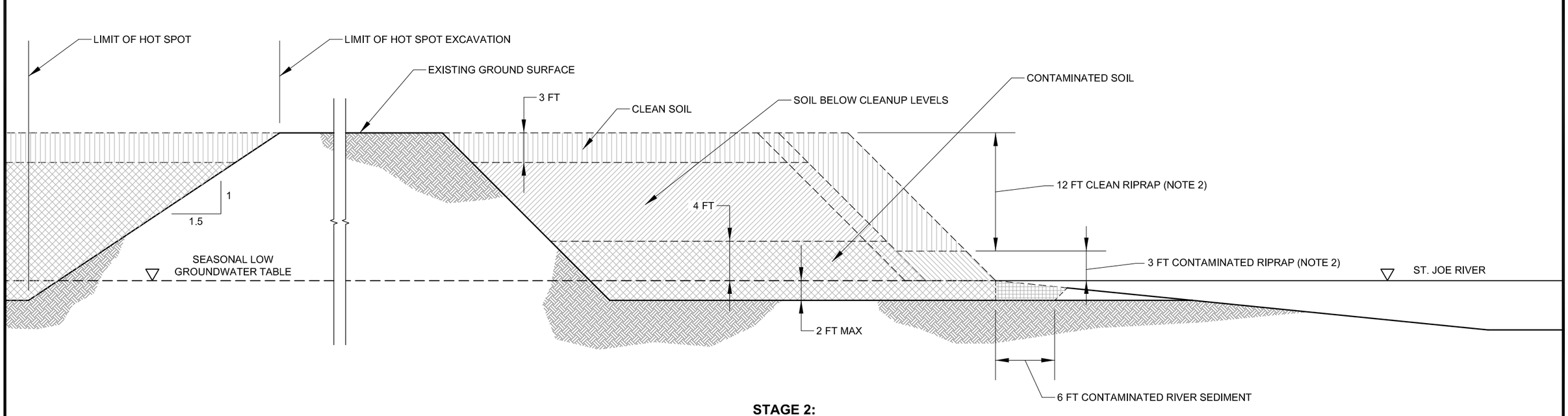
POTLATCH / AVERY LANDING EECA / ID

NOTES

1. DIMENSIONS ARE ASSUMED FOR ESTIMATING PURPOSES.
2. ASSUMED.



STAGE 1:
EXISTING CONDITIONS



STAGE 2:
SHORELINE AND HOT SPOT REMOVAL

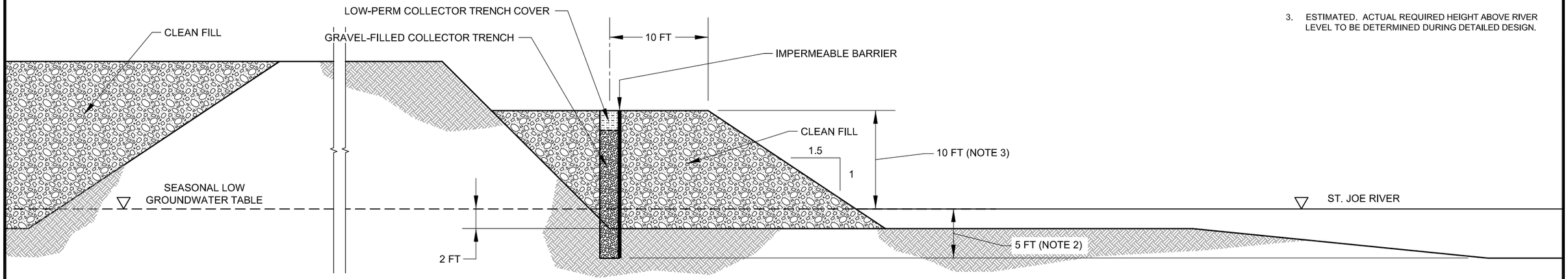
FIGURE **9-7**
HOT SPOT REMOVAL - STAGES 1 AND 2
POTLATCH / AVERY LANDING EECA / ID

K:\CAD\Projects\2007\07393312\x03\09\2009-12-22 Versions\Containment B - Slurry Wall and Hot Spots\073_93312_09 F13 d3.dwg | Stages 1 and 2 | Mod: 01/13/2010, 09:32 | Plotted: 01/13/2010, 09:34 | fshuri

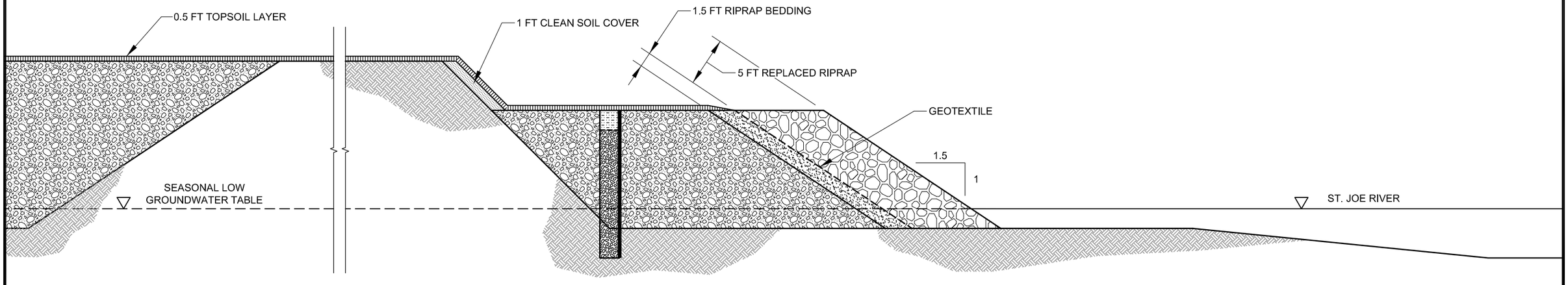
Golder Associates

NOTES

1. DIMENSIONS ARE ASSUMED FOR ESTIMATING PURPOSES.
2. ASSUMED.
3. ESTIMATED. ACTUAL REQUIRED HEIGHT ABOVE RIVER LEVEL TO BE DETERMINED DURING DETAILED DESIGN.



STAGE 3:
FILL AND BARRIER / COLLECTOR TRENCH



STAGE 4:
FINAL CONDITIONS

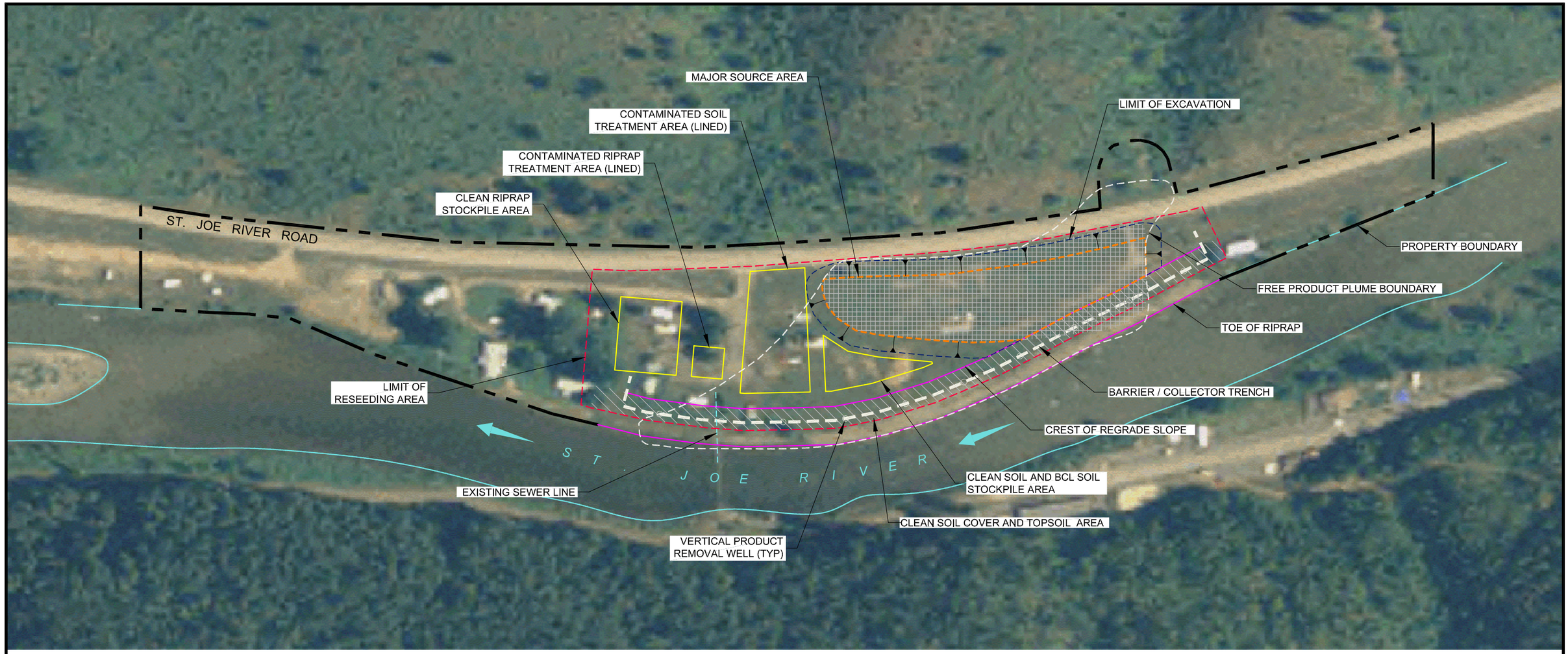
FIGURE **9-8**

HOT SPOT REMOVAL - STAGES 3 AND 4

POTLATCH / AVERY LANDING EECA / ID

K:\CAD\Projects\2007\07393312\x03\09\2009-12-22 Versions\Containment B - Slurry Wall and Hot Spots\073_93312_09 F13 d3.dwg | Stages 3 and 4 | Mod: 01/13/2010, 09:32 | Plotted: 01/13/2010, 09:35 | fshuri

Golder Associates



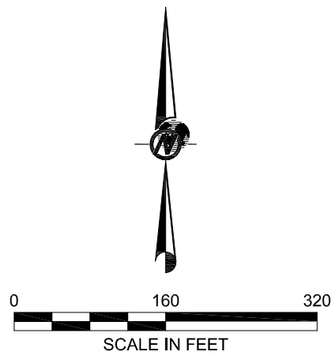


FIGURE **9-9**

MAJOR SOURCE REMOVAL PLAN VIEW

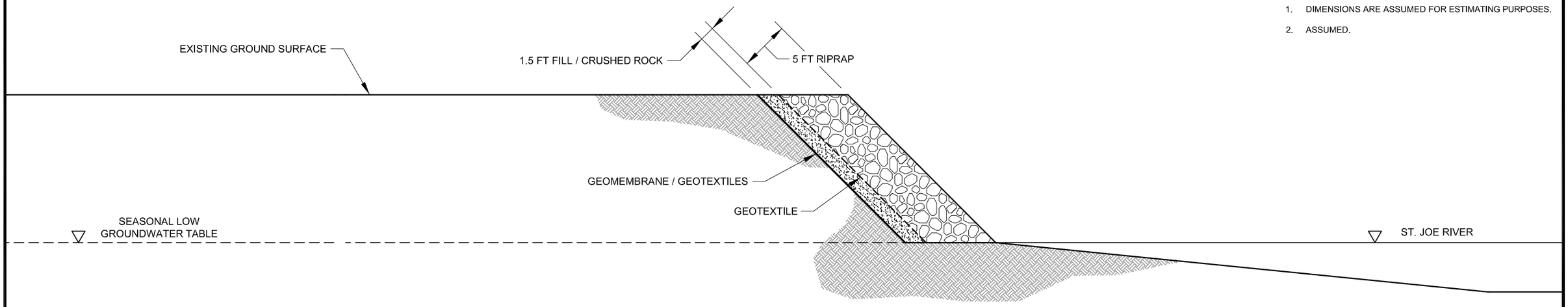
POTLATCH / AVERY LANDING EECA / ID

K:\CAD\Projects\2007\07393312\x03\09\2009-12-22 Versions\Containment C - Slurry Wall and Major Source Removal\073_93312_09 F14 d3.dwg | Plan Facil | Mod: 01/13/2010, 09:41 | Plotted: 01/13/2010, 09:42 | fshuri

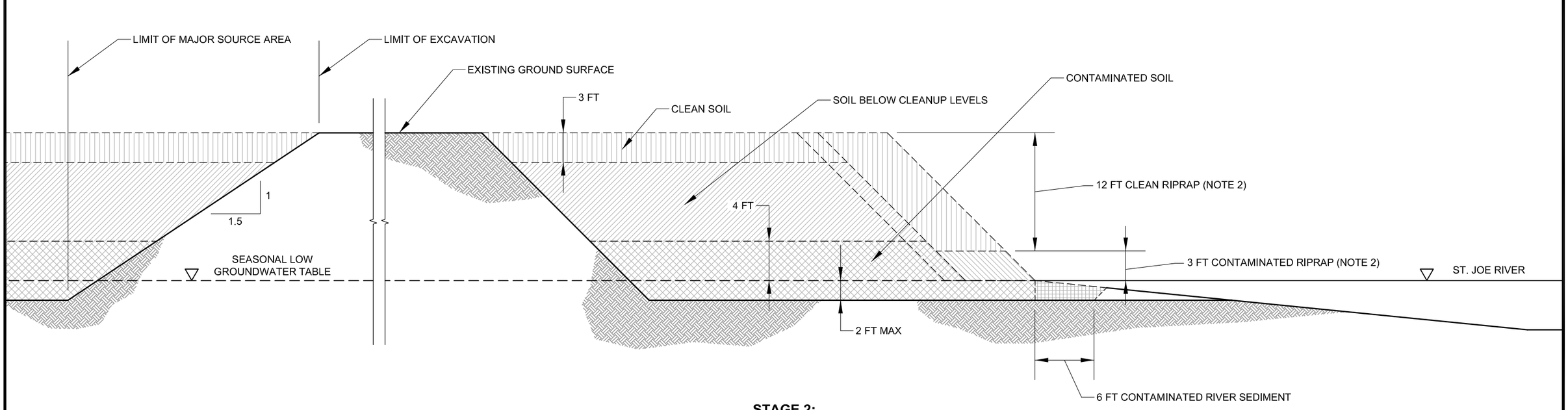
Golder Associates

NOTES

1. DIMENSIONS ARE ASSUMED FOR ESTIMATING PURPOSES.
2. ASSUMED.



STAGE 1:
EXISTING CONDITIONS



STAGE 2:
SHORELINE AND MAJOR SOURCE REMOVAL

FIGURE **9-10**

MAJOR SOURCE REMOVAL - STAGES 1 AND 2

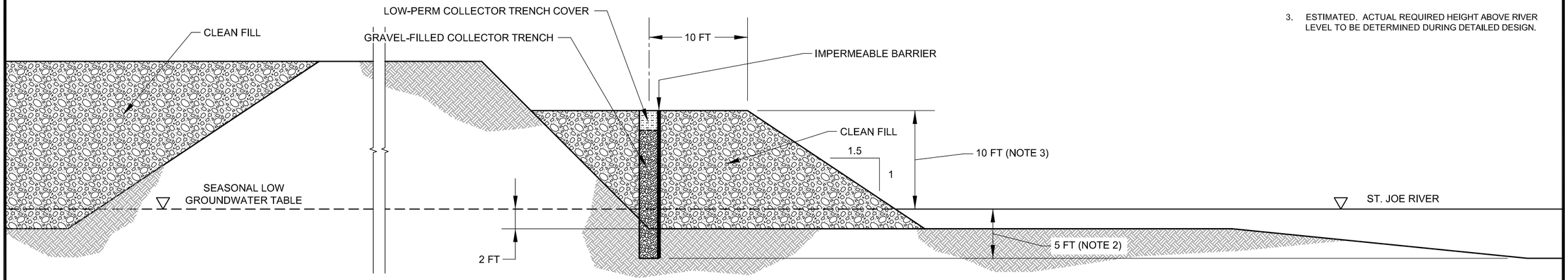
POTLATCH / AVERY LANDING EECA / ID

K:\CAD\Projects\2007\07393312\x03\09\2009-12-22 Versions\Containment C - Slurry Wall and Major Source Removal\073_93312_09 F15 d3.dwg | Stages 1 and 2 | Mod: 01/13/2010, 09:45 | Plotted: 01/13/2010, 09:46 | fshuri

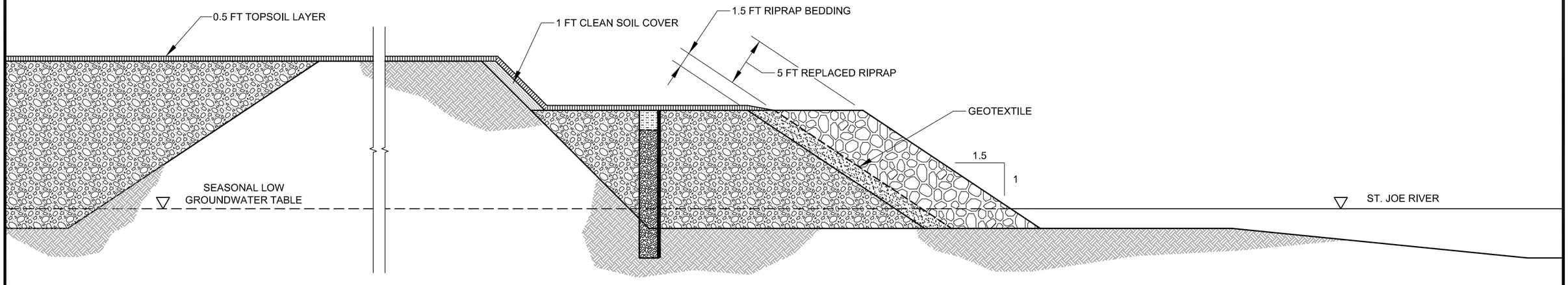
Golder Associates

NOTES

1. DIMENSIONS ARE ASSUMED FOR ESTIMATING PURPOSES.
2. ASSUMED.
3. ESTIMATED. ACTUAL REQUIRED HEIGHT ABOVE RIVER LEVEL TO BE DETERMINED DURING DETAILED DESIGN.



STAGE 3:
FILL AND BARRIER / COLLECTOR TRENCH



STAGE 4:
FINAL CONDITIONS

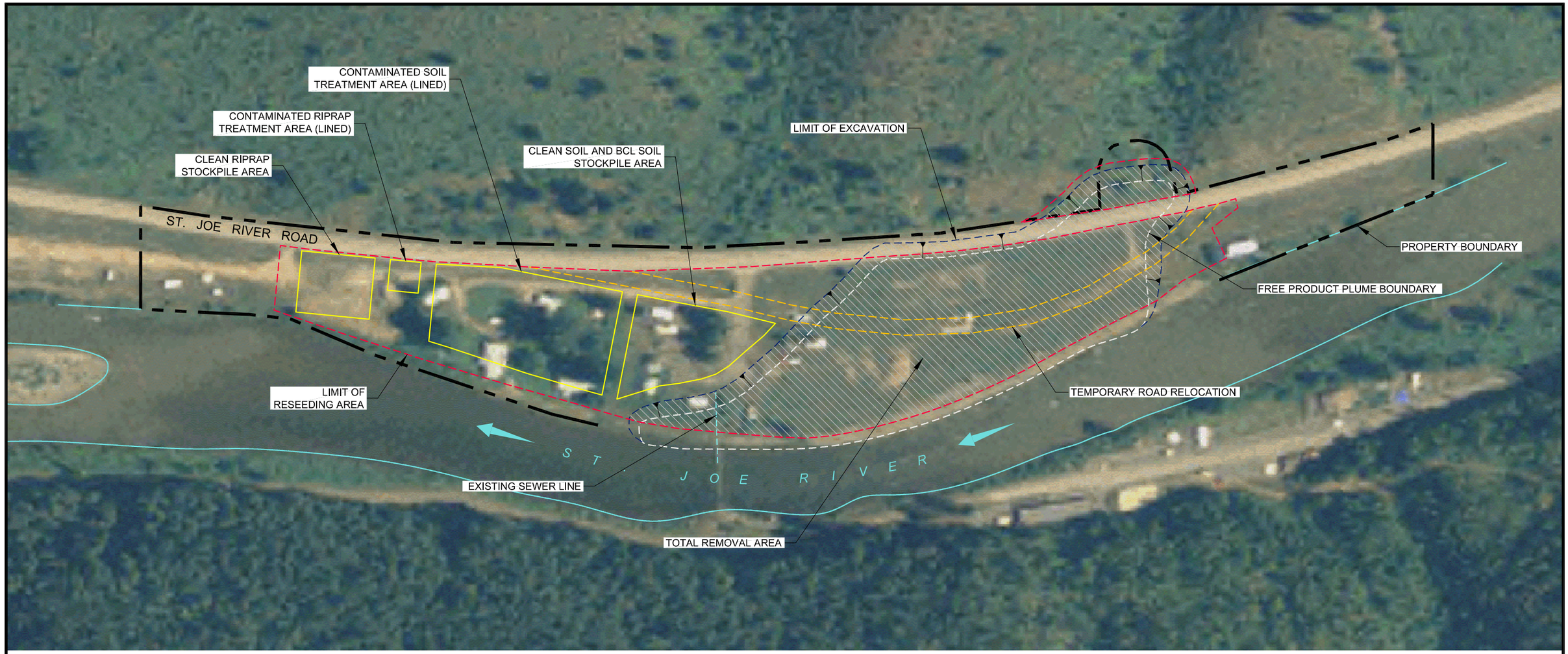
FIGURE **9-11**

MAJOR SOURCE REMOVAL - STAGES 3 AND 4

POTLATCH / AVERY LANDING EECA / ID

K:\CAD\Projects\2007\07393312\x03\09\2009-12-22 Versions\Containment C - Slurry Wall and Major Source Removal\073_93312_09 F15 d3.dwg | Stages 3 and 4 | Mod: 01/13/2010, 09:45 | Plotted: 01/13/2010, 09:46 | fshuri

Golder Associates



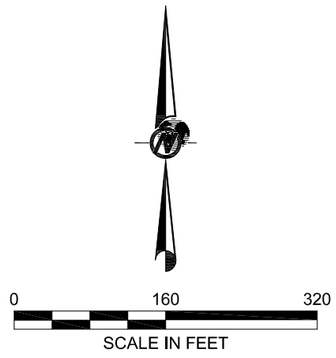


FIGURE **9-12**

TOTAL REMOVAL PLAN VIEW

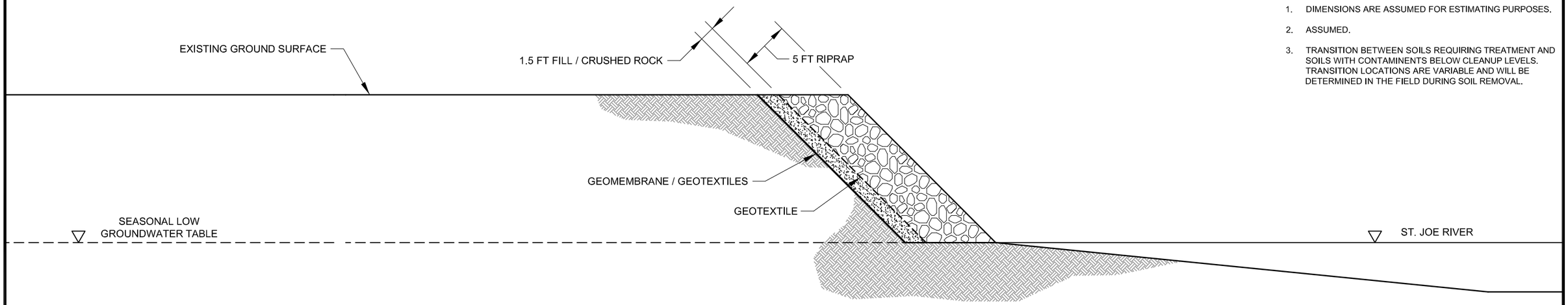
POTLATCH / AVERY LANDING EECA / ID

K:\CAD\Projects\2007\07393312\x03\09\2009-12-22 Versions\Removal Alt D\073_93312_09 F16 d2.dwg | Plan Facil | Mod: 01/08/2010, 13:54 | Plotted: 01/08/2010, 17:12 | fshuri

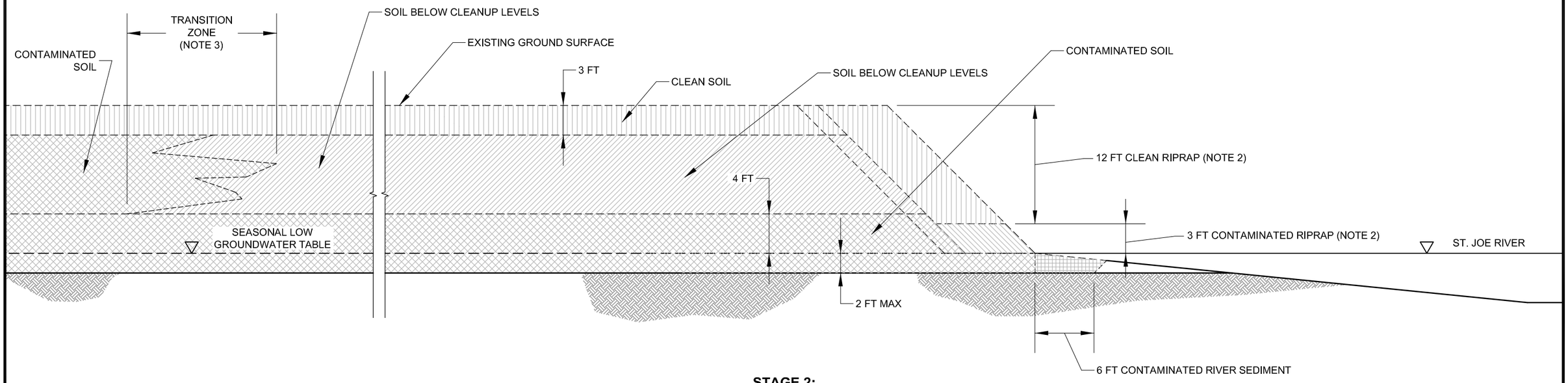
Golder Associates

NOTES

1. DIMENSIONS ARE ASSUMED FOR ESTIMATING PURPOSES.
2. ASSUMED.
3. TRANSITION BETWEEN SOILS REQUIRING TREATMENT AND SOILS WITH CONTAMINENTS BELOW CLEANUP LEVELS. TRANSITION LOCATIONS ARE VARIABLE AND WILL BE DETERMINED IN THE FIELD DURING SOIL REMOVAL.



STAGE 1:
EXISTING CONDITIONS



STAGE 2:
SHORELINE AND TOTAL REMOVAL

FIGURE **9-13**

TOTAL REMOVAL - STAGES 1 AND 2

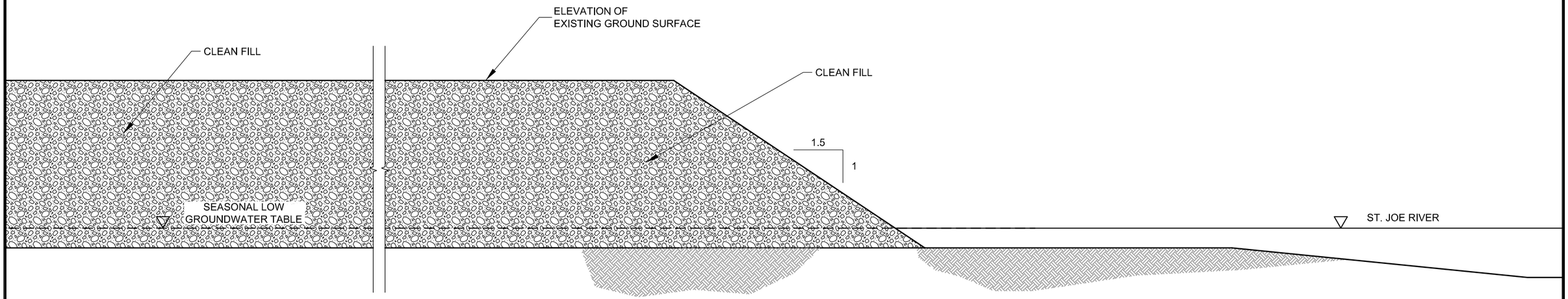
POTLATCH / AVERY LANDING EECA / ID

K:\CAD\Projects\2007\07393312\x03\09\2009-12-22 Versions\Removal Alt D\073_93312_09 F17 d3.dwg | Stages 1 and 2 | Mod: 01/13/2010, 09:53 | Plotted: 01/13/2010, 09:54 | fshuri

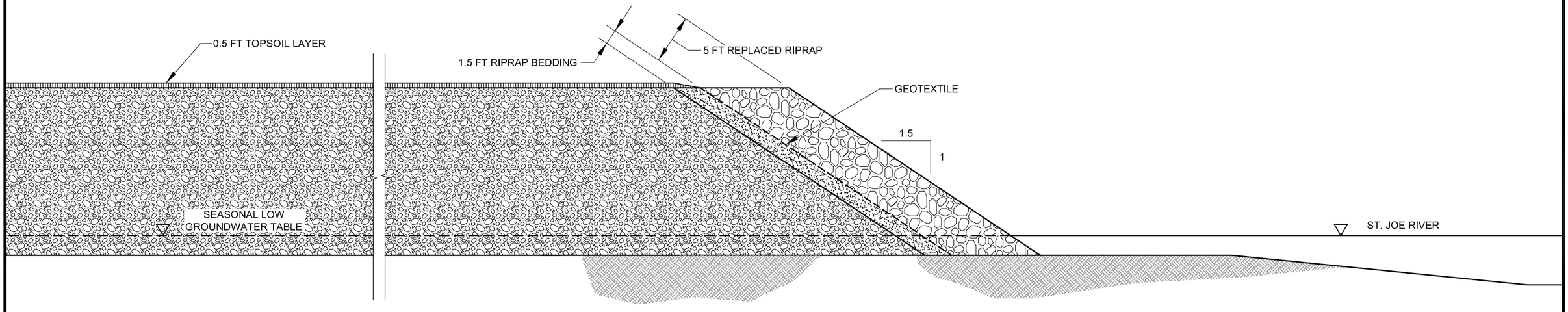
Golder Associates

NOTES

1. DIMENSIONS ARE ASSUMED FOR ESTIMATING PURPOSES.



STAGE 3:
SOIL BACKFILL



STAGE 4:
FINAL CONDITIONS

FIGURE **9-14**
TOTAL REMOVAL - STAGES 3 AND 4
POTLATCH / AVERY LANDING EECA / ID